Civil Works Overview

Introduction

From 1775 to the present, the U.S. Army Corps of Engineers has served the nation in peace and war. The Corps traces its history to June 1775, when the Continental Congress appointed Colonel Richard Gridley as Chief of Engineers of the Continental Army, under General George Washington. The original Corps was the Army's engineering and construction arm until it mustered out of service at the close of the Revolutionary War in 1783.

In 1802, Congress reestablished a separate Corps of Engineers within the Army. At the same time, it established the U.S. Military Academy at West Point, the country's first—and for 20 years its only—engineering school. Because the Army had the nation's most readily available engineering talent, successive Congresses and administrations established a role for the Corps as an organization to carry out both military construction and works "of a civil nature."

Throughout the nineteenth century, the Corps supervised the construction of coastal fortifications, lighthouses, several early railroads, and many of the public buildings in Washington, DC, and elsewhere. Meanwhile, the Corps of Topographical engineers, which enjoyed a separate existence for 25 years (1838-1863), mapped much of the American West. Army engineers served with distinction in time of war, with many engineer officers rising to prominence during the Civil War.

In its civil role, the Corps of Engineers became increasingly involved with river and harbor improvements, carrying out its first harbor and jetty work in the first quarter of the nineteenth century. The Corps' continuing responsibility for Federal river and harbor improvements dates from 1824, when Congress passed two acts authorizing the Corps to survey roads and canals and to remove obstacles on the Ohio and Mississippi rivers. Over the years since, the expertise gained by the Corps in navigation projects led succeeding administrations and Congresses to assign new water-related missions to the Corps in such areas as flood control, shore and hurricane protection, hydropower, recreation, water supply and water quality, and wetland protection.

Today's Corps of Engineers carries out missions in three broad areas: military construction and engineering support to military installations; reimbursable support to other Federal agencies (such as the Environmental Protection Agency's "Superfund" program to clean up hazardous and toxic waste sites); and the civil-works mission, centered on navigation, flood control, and—under the Water Resources Development Acts of 1986, 1988, 1990 and 1992—a growing role in environment restoration.

Authorization and Planning Process for Water-Resource Projects

Corps of Engineers water-resource activities are normally initiated by non-Federal interests, authorized by Congress, funded by a combination of Federal and non-Federal sources, constructed by the Corps under the Civil Works Program, and operated and maintained either by the Corps or by a non-Federal sponsoring agency.

The Water Resources Development Act of 1986 made numerous changes in the way potential new water-resource projects are studied, evaluated, and funded. The major change is that the law now specifies greater non-Federal cost sharing for most Corps water-resource projects.

When local interests feel that improved navigation, flood protection, or other water-resource development is needed, they can petition their representatives in Congress. A Congressional committee resolution or an Act of Congress may then authorize the Corps of Engineers to investigate the problems and submit a report. Except for studies of the inland-waterway navigation system, water-resource studies are conducted in partnership with a non-Federal sponsor, with the Corps and the sponsor jointly funding and managing the study.

For inland-navigation and waterway projects, which are by their nature not "local," Congress, in the Water Resources Development Act of 1986, established an Inland Waterway Users Board, comprising waterway transportation companies and shippers of major commodities. This board advises the Secretary of the Army and makes recommendations on priorities for new navigation projects such as locks and dams. Such projects are funded in part from the Inland Waterway Trust Fund, which in turn is funded by waterway fuel taxes.

Normally, the planning process for a water-resource problem starts with a brief reconnaissance study to determine whether a project falls within the Corps' statutory authority and meets national priorities. Should this be the case, the Corps District where the project is located will carry out a full feasibility study to develop alternatives and select the best possible solution. This process normally includes public meetings to identify the views of local interests regarding the extent and type of improvements desired. The Federal, State, and other agencies with interests in a project are partners in the planning process.

Before making recommendations to Congress for project authorization, the Corps ensures that the proposed project's benefits will exceed its costs, that its engineering design is sound, that the project best serves the needs of the people concerned, and that it makes the wisest possible use of the

natural resources involved and adequately protects the environment.

Once the Corps of Engineers District completes its feasibility study, it submits a report, along with a final environmental impact statement (EIS), to higher authority for review and recommendations. After review and coordination with all interested Federal agencies and the governors of affected states, the Chief of Engineers forwards the report and EIS to the Secretary of the Army, who obtains the views of the Office of Management and Budget before transmitting these documents to Congress.

If Congress includes the project in an authorization bill, enactment of the bill constitutes authorization of the project. Before construction can get under way, however, both the Federal Government and the project sponsor must provide funds. A Federal budget recommendation for a project is based on evidence of State support and the ability and willingness of a non-Federal sponsor to provide its share of the project cost.

The appropriation of money to build a particular project is usually included in the annual Energy and Water Development Appropriation Act, which must be passed by both Houses of the Congress and signed by the President.

Navigation

Corps of Engineers involvement in navigation projects dates back to a time when rivers and coastal harbors were the primary paths of commerce in a new nation. Without its great rivers, the vast, thickly forested region west of the Appalachians would have remained impenetrable to all but the most resourceful early pioneers. Consequently, western politicians such as Henry Clay agitated for Federal assistance to improve rivers. At the same time, the War of 1812 showed the importance of a reliable inland navigation system to national defense.

A question arose, however, as to whether transportation was, under the Constitution, a legitimate Federal activity. This question was resolved when the Supreme Court ruled that the Commerce Clause of the Constitution granted the Federal Government the authority, not only to regulate navigation and commerce, but also to make necessary navigation improvements.

The system of harbors and waterways maintained by the Corps of Engineers remains one of the most important parts of the nation's transportation system. The Corps maintains the nation's waterways as a safe, reliable, and economically efficient navigation system. The 12,000 miles of inland waterways the Corps maintains carry one sixth of the nation's intercity cargo. The importance of the Corps' mission in maintaining depths at more than 500 harbors throughout the states is underscored by an estimated one job in five that to some extent depends on the commerce handled by these ports.

Flood Control and Floodplain Management

Federal interest in flood control began in the alluvial valley of the Mississippi River in the mid-19th century. As the relationship between flood control and navigation became apparent, Congress called on the Corps of Engineers to use its navigational expertise to devise solutions to flooding problems along the river.

After a series of disastrous floods affecting wide areas in the 1920s and 30s, Congress determined, in the Flood Control Act of 1936, that the Federal Government would participate in the solution of flooding problems affecting the public interest that were too large or complex to be handled by states or localities. Corps authority for flood-control work was thereby extended to embrace the entire country. The Corps turns over most of the flood-control projects it builds to non-Federal authorities for operation and maintenance once construction is completed.

The purpose of flood-control work is to prevent damage through regulation of the flow of water and by other means. The prevention of flood-related damage can be accomplished with structural measures, such as reservoirs, levees, channels, and floodwalls, that modify the characteristics of floods; or nonstructural measures, such as floodplain evacuation, floodproofing, and floodway acquisition, that alter the way people use these areas and reduce the susceptibility of human activities to flood risk.

Corps flood-control reservoirs are often designed and built for multipurpose uses, such as municipal and industrial water supply, navigation, irrigation, hydroelectric power, conservation of fish and wildlife, and recreation.

The Corps fights the nation’s flood problems not only by constructing and maintaining structures, but also by providing detailed technical information on flood hazards. Under the Floodplain Management Services Program, the Corps provides, on request, flood-hazard information, technical assistance, and planning guidance to other Federal agencies, states, local governments, and private citizens. Once community officials know the flood-prone areas in their communities and how often floods are likely to occur, they can take necessary action to prevent or minimize damage to both existing and new buildings and facilities, such as adopting and enforcing zoning ordinances, building codes, and subdivision regulations. The Floodplain Management Services Program provides assistance to other Federal and State agencies in the same manner.

Shore and Hurricane Protection

Corps work in shore protection began in 1930, when Congress directed the Corps to study ways to reduce erosion along U.S. seacoasts and the Great Lakes. Hurricane protection work

was added to the erosion control mission in 1955, when Congress directed the Corps to conduct investigations along the Atlantic and Gulf coasts to identify problem areas and determine the feasibility of protection.

While each situation the Corps studies involves different considerations, Corps engineers always consider engineering feasibility and economic efficiency along with the environmental and social impacts. Federal participation in a shore protection project varies, depending on shore ownership, use, and the type and frequency of benefits. (If there is no public use or benefit, the Corps will not recommend Federal participation.) Once the project is complete, non-Federal interests assume responsibility for its operation and maintenance.

Eighty-two Federal shore protection projects along the coasts of the Atlantic, Pacific, Gulf of Mexico and the Great Lakes protect a total of 226 miles of shoreline. Total investment in these projects since 1950 has been $674 million - $405 million provided by the Federal Government, the rest by non-Federal sponsors.

One method of shore protection popular in seaside communities is beach nourishment—the periodic replenishment of sand along the shoreline to replace the sand lost to storms and erosion. Authorized nourishment projects usually have a nourishment period of 50 years. In addition, Section 145 of the Water Resources Development Act of 1976 authorizes placement of beach-quality sand from Corps dredging projects on nearby beaches. Under Section 933 of the Water Resources Development Act of 1986, local sponsors pay the Federal Government 50 percent of the additional costs of this placement of sand.

Hydropower

The Corps has played a significant role in meeting the nation’s needs for electric-power generation by building and operating hydropower plants in connection with its large multipurpose dams. The Corps’ involvement in hydropower generation began with the Rivers and Harbors Acts of 1890 and 1899, which required the Secretary of War and the Corps of Engineers to approve the sites and plans for all dams and to issue permits for their construction. The Rivers and Harbors Act of 1909 directed the Corps to consider various water uses, including water power, when submitting preliminary reports on potential projects.

The Corps continues to consider the potential for the development of hydroelectric power during the planning process for all water-resource projects involving dams and reservoirs. In most instances today, non-Federal interests develop hydropower facilities at Corps projects without Federal assistance. However, the Corps can plan, build, and operate hydropower projects when it's impractical for non-Federal interests to do so. Today, the more than 20,000 megawatts of capacity at Corps-operated power plants provide approximately 24 percent of the nation's hydroelectric power, or 3 percent of its total supply of electric energy.

Water Supply

Corps involvement in water supply dates back to 1853, when it began building the Washington Aqueduct, which provides water to the nation's capital city and some of its suburbs to this day.

Elsewhere in the nation, the Water Supply Act of 1958 authorized the Corps to provide additional storage in its reservoirs for municipal and industrial water supply at the request of local interests, who must agree to pay the associated costs. The Corps also supplies water for irrigation, under terms of the Flood Control Act of 1944. This act permits the Secretary of War, upon the recommendation of the Secretary of the Interior, to authorize the use of Corps reservoirs for irrigation, provided that users agree to repay the Government for the water.

Recreation

The Flood Control Act of 1944, the Federal Water Project Recreation Act of 1965, and language in specific project-authorization acts authorize the Corps to construct, maintain, and operate public park and recreation facilities at its projects, and to permit others to build, maintain, and operate such facilities. The water areas of Corps projects are open to public use for boating, fishing, and other recreational purposes.

The Corps of Engineers today is one of the Federal Government's largest providers of outdoor recreational opportunities, operating more than 4,300 sites at its lakes and other water-resource projects. More than 370 million visits a year are recorded at these sites. State and local park authorities and private interests operate nearly 2,000 other areas at Corps projects.

Environmental Quality

The Corps carries out the Civil Works Programs in compliance with many environmental laws, executive orders, and regulations. Perhaps primary among these is the National Environmental Policy Act (NEPA) of 1969. This law requires Federal agencies to study and consider the environmental impact of their proposed actions. Consideration of a Corps project's environmental impact begins in the early stages and continues through the project's design, construction, and operation. The Corps must also comply with these environmental laws and regulations in conducting its regulatory programs.

NEPA procedures ensure that public officials and private citizens obtain and provide needed environmental information before Federal agencies make decisions concerning the environment. In selecting alternative project designs, the Corps strives to choose options that entail minimum environmental impact.

The Water Resources Development Act of 1986 authorizes the Corps to propose modifications of its existing projects—many of them built before current environmental requirements were in effect—for environmental improvement. Proposals the Corps has made under this authority range from the use of dredged material to create nesting sites for waterfowl to modification of water-control structures to improve downstream water quality for fish.

In recent years, the Corps of Engineers has planned and recommended environmental restoration actions at Federal projects to restore environmental conditions.

Regulatory Programs

The Corps of Engineers regulates construction and other work in navigable waterways under Section 10 of the Rivers and Harbors Act of 1899, and has authority over the discharge of dredged or fill material into the “waters of the United States”—including wetlands and all other aquatic areas under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, the "Clean Water Act"). Under these laws, those who want to carry out such work must first obtain a permit from the Corps.

The “Section 404” program is the Federal Government's main resource for protecting wetlands and other aquatic environments. The program's goal is to ensure protection of the aquatic environment while allowing for necessary economic development.

The permit evaluation process includes a public notice and a public comment period. Applications for complex projects may also require a public hearing before the Corps makes a permit decision. In its evaluation of applications, the Corps is required by law to consider all factors involving the public interest. These may include economics, environmental concerns, historical values, fish and wildlife, aesthetics, flood-damage prevention, land-use classifications, navigation, recreation, water supply, water quality, energy needs, food production, and the general welfare of the public.

The Corps of Engineers has issued a number of nationwide general permits, mostly for minor activities that have little or no environmental impact. Individual Corps districts have also issued regional permits for certain types of minor work in specific areas. Individuals who propose work that falls under one of these general or regional permits need not go through the full standard individual permit process. However, many authorizations of general permits do involve substantial effort by the Corps, and often require project-specific mitigation for the activities authorized by the permit. Corps districts have also issued State Program General Permits for work in states that have comprehensive programs of wetland protection. These permits allow applicants to do work for which they have received a permit under the state program. These general permits reduce delays and paperwork for applicants and allow the Corps to devote its resources to the most significant cases while maintaining the environmental safeguards of the Clean Water Act.

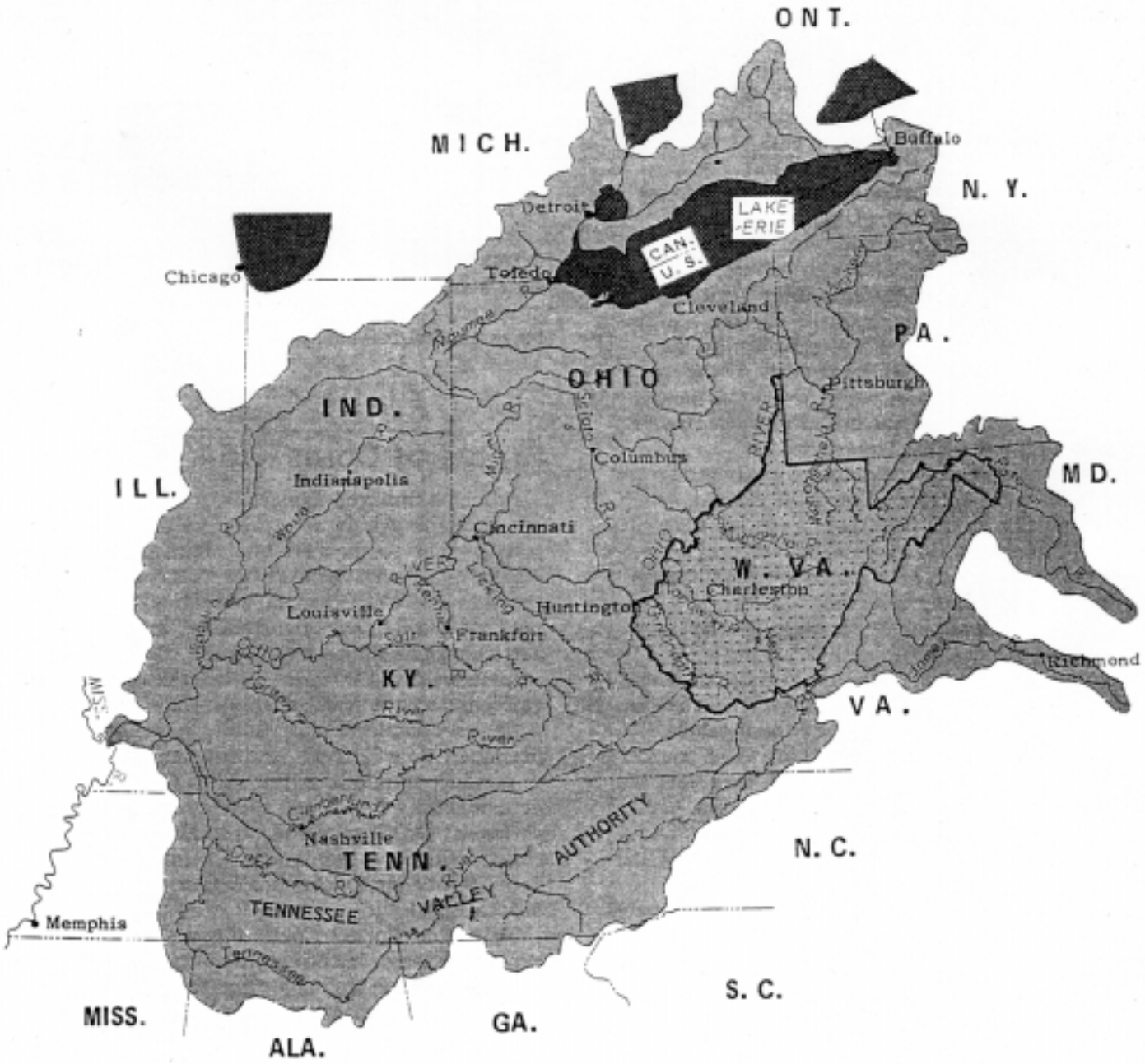
Emergency Response and Recovery

The Corps provides for emergency responses to natural disasters under Public Law 84-99, which covers flood control and coastal emergencies. It also provides emergency support to other agencies, particularly the Federal Emergency Management Agency (FEMA), under Public Law 93-288 (the Stafford Act) as amended.

Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to carry out disaster preparedness work; advance measures; emergency operations such as flood fighting and rescue and emergency-relief activities; rehabilitation of flood-control works threatened or destroyed by flood; and protection or repair of Federally authorized shore-protection works threatened or damaged by coastal storms. This act also authorizes the Corps to provide emergency supplies of clean water in cases of drought or contaminated water supply. After the immediate flooding has passed, the Corps provides temporary construction and repairs to essential public utilities and facilities and emergency access for a 10-day period, at the request of the governor and prior to a Presidential Disaster Declaration.

Under the Stafford Act and the Federal Disaster Response Plan, the Corps of Engineers, as designated by the Department of Defense, is responsible for providing public works and engineering support in response to a major disaster or catastrophic earthquake. Under this plan, the Corps, in coordination with FEMA, will work directly with State authorities in providing for such necessities as, for example, temporary repair and construction of roads, bridges, and utilities, temporary shelter, debris removal and demolition, and water supply. The Corps is the lead Federal agency tasked by FEMA to provide engineering, design, construction, and contract management in support of recovery operations.

REGIONAL MAP



Boundaries of Lake Erie basin; Ohio, Potomac and James River basins; and Tennessee Valley Authority (Tennessee River basin).

West Virginia Summary

Description of Area

The mountains of the Mountain State, West Virginia, are neither the nation's highest nor the highest in the Eastern United States. West Virginia is known as the Mountain State because the land is extremely rugged. The limited amount of level land is confined mainly to narrow strips along the banks of the larger streams and atop some of the ridges. The average elevation is around 1500 feet above sea level, the highest of any state east of the Mississippi River.

The state shares with Alaska the distinction of having the most irregular outline of any of the states, and of having two panhandles. The irregularity of outline results from the border's being defined mainly by natural features, such as rivers and ridgetops. The Ohio River forms the larger part of the western boundary, with the Big Sandy River and its tributary, the Tug Fork, constituting the remainder. Mountain ridges form large parts of the southern and eastern boundaries, while in the northeast, bordering Maryland, the Potomac and the North Branch Potomac make up most of that boundary.

West Virginia's drainage is mainly northwestward to the Ohio River, then to the Mississippi and the Gulf of Mexico. However, a portion in the northeast, about 15 percent of the state, is drained by the Potomac River system to the Atlantic Ocean. A long segment of the mountainous West Virginia-Virginia border coincides with the Appalachian Divide, separating the drainage to the Atlantic from that to the Gulf.

Major tributaries of the Ohio that drain parts of West Virginia are the Monongahela, Little Kanawha, Kanawha, Guyandotte, and Big Sandy rivers. The Monongahela, Little Kanawha, and Guyandotte rivers have their sources in West Virginia. The North and South Branches of the Potomac River, and the Cacapon, another Potomac River affluent, also have their sources in West Virginia. The Kanawha, however, takes its source in headstreams of the New River, in northwestern North Carolina and southwestern Virginia. Important Kanawha-New River tributaries rising in West Virginia include the Coal, Elk, Gauley, and Greenbrier rivers.

West Virginia's population is largely rural, even though the state contains all or portions of six metropolitan statistical areas. Of the 1990 population of 1,815,787, 36 percent live in metropolitan areas and 64 percent live in rural areas. The state has lost population in recent decades, but its population density remains higher than the national average; five counties exceed 250 people per square mile. On the other hand, one county (Pocahontas) has under 10 to the square mile. Large parts of the state are in national forests or state parks, which helps make West Virginia an attractive playground for the people of the state and the nation.

The state's forests are one of nature's wonders, and the great variety of wood and associated products make the timberlands a valuable economic resource. Probably no other state is so favorable to the development of deciduous forests. More than 50 species of deciduous trees are native to the state. The extent and diversity of the woodland environment provide an abundant supply of natural foods for wildlife, and the state provides some of the best hunting areas in the east.

Although West Virginia is a major producer of the nation's coal, manufacturing is the largest sector of the state's economy. All segments of the economy are intimately concerned with the water-resource development carried forward under Corps of Engineers direction.

Status of Corps Work

Fifteen completed navigation projects whose pools adjoin or are within West Virginia state boundaries make substantial contributions to the state and national economies.

Nine multipurpose lakes have been completed and are in operation in West Virginia, providing flood protection, outdoor recreational opportunities, low-flow regulation, and fish and wildlife conservation. One is under construction and three are in inactive authorized status. One has recently been deauthorized.

Eleven completed local flood-protection projects have permitted state residents and industries protected by them to conduct their affairs free from the interruptions occasioned by flooding and its consequences. Two local flood-protection projects are under construction, two are in inactive authorized status. Twenty-four local flood-protection projects have been deauthorized.

Thirty-one Special Continuing Authority projects have been completed, including three small flood-control projects, 17 snagging and clearing projects, and eight emergency bank-protection projects. Three involved emergency rehabilitation. Three emergency bank-protection projects are under construction, and one has been approved for construction but has not been started.

Many planning studies are authorized and some are under way, concerned with a wide range of water and related land resource problems. Twenty-four floodplain information reports have been completed.

Ohio River Basin in West Virginia

The Ohio River basin has a drainage area of 204,000 square miles, extending over parts of 14 states in the middle eastern part of the United States. The topography ranges from rugged uplands to undulating or relatively level plains. The eastern portion of the basin, extending from southwestern New York to northern Georgia and including most of West Virginia, is dominated by the rugged terrain of the Appalachian Highlands, in part mountainous, in larger part dissected plateau. Westward, in a belt on either side of the Ohio River, and to the south, much of the topography is still rough, though with some areas of fairly subdued terrain through central and western Kentucky and Tennessee. In the broad areas of glacial deposition north of the Ohio River, plains topography is characteristic.

The population of the Ohio River basin is most heavily concentrated in the north and northeast, including Pittsburgh (pop. 350,353), Columbus (657,053), Cincinnati (345,818), Louisville (250,589), and Indianapolis (745,737). Situated between the populous East and the upper Mississippi River basin, it's a natural transportation corridor, a significant producer of raw materials, and the site of hundreds of manufacturers.

The Ohio River basin accounts for more than 75 percent of the nation's bituminous coal production, much of which comes from West Virginia. However, manufacturing is the largest source of income and employment in West Virginia. The largest concentrations of people in the state are along the Ohio River and its major tributary, the Kanawha.

Bottomlands of the Ohio River basin are naturally subject to occasional damaging and sometimes devastating floods. However, a system of reservoirs and local protection projects is now operative throughout the basin, which should reduce flood damage significantly. At the same time, during the record low flow of 1963, reservoir storage was sufficient to more than double the Ohio River flow at Cincinnati.

Perhaps no other river basin in the United States had greater problems with water pollution than those faced in 1945 by the eight states that signed the compact establishing the Ohio River Valley Water Sanitation Commission (ORSANCO). Significant progress has been made through the combined efforts of communities and industries in curbing water pollution. Water quality is being improved through the construction of sewage treatment facilities, the prevention of mine-acid discharges into streams, the continuous checking of water quality by “robot monitors,” keeping inventories of aquatic-life resources for judging the effectiveness of pollution control, laboratory analysis of water samples, the treatment of industrial wastes, and continuous visual surveillance. Accomplishments in the elimination of gross pollution and further refinements in control and practice will ensure the optimum use of water resources for the Ohio River basin.

Because of the predominant position of the Tennessee Valley Authority in connection with the Tennessee River basin, the 41,000 square miles of the Tennessee River drainage area is commonly excluded in reports referring to the Ohio River basin. This is notably true of the *Ohio River Basin Comprehensive Survey*, published in 1969, which covers the remaining 163,000 square miles. That study provides a general appraisal of the existing plan for developing water- and related land-resource needs of the basin now and through the year 2020.

The larger part of West Virginia is located in the Ohio River basin. The basin in West Virginia contains eight Corps multipurpose lake projects and a number of navigation structures and local flood-protection projects.

Descriptions of Corps of Engineers projects and activities in the Ohio River basin portion of West Virginia are presented in the following sections of this booklet. Attention is given first to those along the Ohio River, and then to those in the various subbasins, arranged in geographic order, beginning with the upstream affluents and proceeding downriver.

Ohio River in West Virginia

Description of Area

The Ohio River follows an irregular course extending from the West Virginia-Pennsylvania line to the West Virginia-Kentucky line for 277 miles. Throughout this frontage on the Ohio River, West Virginia borders the state of Ohio. Eighty-seven miles of West Virginia's frontage on the Ohio River is in the Pittsburgh District of the Corps of Engineers, 190 miles in the Huntington District.

Most of West Virginia is drained through the Ohio and Mississippi rivers to the Gulf of Mexico. The state's eastern panhandle is drained by way of the Potomac River to the Chesapeake Bay.

The lowest point on the Ohio River in West Virginia is at the junction with the Big Sandy River, which is 515 feet above sea level. Most of the counties touching the Ohio have hills that reach elevations between 1200 and 1600 feet. The most significant topographic features along the river are the broad and fertile bottomlands.

The largest of the communities along the Ohio in West Virginia is Huntington (pop. 54,623). Modern industrial facilities are scattered at choice locations along the river and are a conspicuous feature of the landscape. However, the bottomlands are used predominantly for agriculture. Major rail and highway arteries parallel the river, which itself is a vital part of the nation's inland waterway system.

Status of Corps Work

Along the Ohio River in West Virginia, eight navigation projects (lock and dam structures) are in operation. (These include Greenup Locks and Dam, 24 miles downstream from West Virginia. Greenup's pool extends past Huntington to Robert C. Byrd Locks and Dam.) Of the 30 local flood- protection projects that have been specifically authorized by Congress, four have been completed, two are in inactive authorized status, and 24 have been deauthorized. Two snagging and clearing projects and emergency repairs to a local flood-protection project have been carried out under special continuing authorities. Seven emergency bank-protection projects have been built under a special continuing authority, one is under construction, and one has been approved but has not been started. A public-access-site project has been carried out at Huntington under a cost-sharing program.

Hydroelectric power is being generated under Federal Energy Regulatory Commission license at Racine, Hannibal, and Greenup dams on the Ohio River, and consideration is being given to hydropower at other navigation projects.

One major planning study touching the Ohio River in West Virginia is in progress.

Twelve floodplain information studies relating to locations along the river have been completed. No further studies are now planned or under consideration.

In the following discussions, the Ohio River navigation system is presented first, followed by descriptions of local flood-protection projects and other improvements. Planning studies and floodplain information studies relating to locations along the river complete the presentation.

Ohio River Navigation System

Ohio River Division

The Ohio River flows 981 miles from the junction of the Allegheny and Monongahela rivers at Pittsburgh to the Mississippi River near Cairo, IL. The entire river has been improved by the construction of locks and dams to provide a channel depth of 9 feet, and by open channel work to remove obstructions and ensure adequate channel widths.

The improvement of navigation on the Ohio River was begun by the Corps of Engineers in 1825 with dredging over sandbars and the removal of snags. The first major improvement was a canal with a set of three locks, built by private interests and opened for use in 1830, to pass the “Falls of the Ohio” at Louisville. Corps improvements over a 60-year period consisted of clearing wrecks and snags, channel dredging, and building training dikes and jetties.

Eventually, however, because the Ohio was too shallow for navigation almost every summer and fall , Congress authorized the construction of a series of locks and dams. The first of these was completed in 1885 about 5 miles below Pittsburgh, and 12 more were built before 1910. The canalization of the river was completed in 1929. By then, 50 lock and dam structures were in operation, ensuring a year-round depth of 9 feet from the Mississippi River to Pittsburgh. The first dams were built with wooden wickets that were raised to hold back water during periods of low flow and dropped to the river bottom during high water to permit open river navigation without the need for locking through.

By 1937, the Emsworth, Dashields, Montgomery, and Gallipolis projects were in operation. These new structures reduced the navigation system to 46 locks and dams along the Ohio River. With a few exceptions, the dams were of the movable type, with a navigable pass ranging from 600 to 1,248 feet and one or more regulating weirs. The lock at each dam was 110 feet by 600 feet.

Of the existing Ohio River locks and dams whose pools touch West Virginia, only the Robert C. Byrd Locks and Dam was

built under authority of the River and Harbor Act of 1935. The others were built under authority of the Act of 1909.

Originally, channels for steamboats were 400 to 600 feet wide at shallow points and across bars, and ice piers provided shelter from ice floes. For the more powerful modern towboats, a 300-foot-wide minimum-width channel is now maintained.

More than 270 miles of the improved waterway is located along the boundary between West Virginia and Ohio. The improved waterway provides both direct access for the shipment and receipt of commodities over the far-flung inland navigation system, and provides a connection with the Great Lakes system and the Gulf Intracoastal Waterway. Along with tributaries improved for navigation, the Ohio River is a vital part of the Mississippi River navigation system.

More than two-thirds of the freight traffic is made up of bulk forms of energy - coal, crude oil, and petroleum products. Other major commodities transported are iron, steel, and grain. Average annual traffic on the Ohio River for the 5-year period ending in 1993 was 221 million tons. The traffic for 1993 totaled 228 million tons which has grown to 323 million tons for 1997.

The Ohio River is also a 981-mile-long series of recreational lakes. The stable pools above the dams have substantial private shorefront recreational development, and provide some 5600 berths for small boats. Federally developed access points along the pools, providing launching ramps and parking areas, had nearly 1,733,000 recreational visitors in 1997.

The Ohio River carries an increasing amount of freight. Waterborne traffic of 22 million tons in 1930 grew to 323 million tons in 1997. There has also been a steady development in towing equipment, resulting in larger barges, longer tows, and more powerful towboats.

To improve efficiency, meet new needs, and permit additional growth, a replacement and modernization program for the navigation system was started in the early 1950s. The Ohio River now has 18 nonnavigable crest dams and two navigable dams, each with dual lock chambers, of which, with four exceptions, at least one is 1200 feet long and 110 feet wide. The modern dams are higher than the older ones, each eliminating two or three of the older structures so that tows can move longer distances between lockages. Since the modernization program began in 1955, the number of dams in operation has been reduced from 46 to 20.

The total cost for construction work for the Ohio River navigation development as of 30 September 1984 was $1.38 billion. This includes about $88 million for the replacement of old structures, but excludes $528 million for operation, maintenance, and rehabilitation.

The following are descriptions of the individual Ohio River navigation structures in West Virginia, beginning with the project farthest upstream.

New Cumberland Locks and Dam
West Virginia, Ohio, and Pennsylvania
Pittsburgh District

New Cumberland Locks and Dam is located at Stratton (pop. 292), Ohio, just upstream from New Cumberland (1,363), West Virginia. The navigation pool has a minimum channel depth of 9 feet and extends about 23 miles to Montgomery Locks and Dam. The project was completed in 1961, replacing three obsolete lock and dam structures.

The two parallel locks are located on the Ohio side of the river. The usable dimensions of the riverward and landward lock chambers are 110 feet by 1200 feet and 110 feet by 600 feet, respectively. The larger lock can accommodate in one lockage the larger type of Ohio River tow that formerly required uncoupling and reassembly in order to be locked through the replaced obsolete facilities. The use of such larger tows has steadily increased in recent years.

The navigation pool is maintained by a nonnavigable gated dam 1,315 feet in length. The lift of the locks at normal pool stages is 20.5 feet.

The New Cumberland project was the first completed element in the overall improvement program for the modernization of navigation facilities on the Ohio River. The total Federal cost was $39.1 million.

Pike Island Locks and Dam
West Virginia and Ohio
Pittsburgh District

Pike Island Locks and Dam is located 2 miles upstream from Warwood, a part of Wheeling (pop. 33,959), West Virginia. The project provides a pool with a minimum channel depth of 9 feet, extending almost 30 miles to New Cumberland Locks and Dam. It replaced obsolete Lock and Dam 10 and Lock and Dam 11 and raised the level of a substantial portion of the pool of Lock and Dam 12.

The locks are located in Ohio County, on the West Virginia side of the Ohio River. The dimensions of the riverward and landward lock chambers are 110 by 1200 feet and 110 by 600 feet, respectively. The dam is a nonnavigable gated structure, 1,306 feet long. The lift of the locks at normal pool level is 21 feet.

Hannibal Locks and Dam
West Virginia and Ohio
Pittsburgh District

Hannibal Locks and Dam is located on the Ohio River at Hannibal (pop. 525), Ohio, about 1.5 miles upstream of New Martinsville (6,634). The project replaced obsolete locks and dams 12, 13, and 14. The dam provides a pool with a minimum navigable depth of 9 feet, extending 42 miles to Pike Island Locks and Dam.

The two parallel locks, 110 feet wide and 1200 and 600 feet long, respectively, are on the Ohio side of the river. The dam is a nonnavigable gated structure 1,098 feet long, with a lift of 21 feet between normal pools.

Lock construction began in 1966 and was completed in 1970. The dam was started in 1970 and was completed in 1975. The Federal cost was $87,260,000.

A full-scale display relating to the former low-lift movable dams, including a maneuver boat, has been installed at Hannibal Locks and Dam.

The City of New Martinsville, under license from the Federal Energy Regulatory Commission, built, and in 1988 began operating, a hydroelectric power plant at the dam's left abutment on the West Virginia side of the Ohio River. The plant contains two generating units with a total capacity of 34,000 kilowatts.

Willow Island Locks and Dam
West Virginia and Ohio
Huntington District

Willow Island Locks and Dam is located at Willow Island, West Virginia. The structure replaced obsolete locks and dams 15, 16, and 17. The dam provides a pool with a minimum navigable depth of 9 feet, extending 35 miles to Hannibal Locks and Dam. The two parallel locks are on the Ohio side of the river. The usable dimensions of the main lock chamber and auxiliary lock are 110 by 1200 feet and 110 by 600 feet, respectively. The dam is a nonnavigable gated structure, 1,128 feet long, with a lift of 20 feet. The locks were completed and placed in use in 1972, and the dam was completed in 1976. The overall project cost was $78,170,000.

Boat-launching ramps have been built in the Willow Island pool at St. Marys and New Martinsville, West Virginia. Fisherman access facilities are available at the abutment site (West Virginia side of the river) below the dam. The New Martinsville site was conveyed to the City of New Martinsville.

Recreational facilities at the locks include parking, picnic shelters, picnic tables, and an observation platform. Visitation in 1997 totaled 413,800.

The U.S. Federal Energy Regulatory Commission issued a FERC license to the City of New Martinsville, West Virginia, on 27 September 1989 for a term of 50 years. This license permits the construction, operation, and maintenance of a hydroelectric facility. To date, construction has not started. In June 1993, the U.S. Department of Interior was issued a Corps permit to install and operate water-quality instruments. When the facility is completed, it will contain fishing-access facilities.

Belleville Locks and Dam
West Virginia and Ohio
Huntington District

Belleville Locks and Dam is located on the Ohio River between Belleville (pop. 50), West Virginia, and Reedsville (300), Ohio. The project replaced three obsolete locks and dams on the Ohio River and one on the Muskingum. The dam provides a pool with a minimum navigable depth of 9 feet, extending 42 miles to Willow Island Locks and Dam. The two lock chambers, a main lock and an auxiliary lock located side by side, have usable dimensions of 110 feet by 1200 feet and 110 feet by 600 feet, respectively. The dam is a nonnavigable gated structure with a lift of 22 feet. It was completed for operation in 1969 at a Federal cost of $62,200,000.

Boat launching ramps have been built at four locations in the navigational pool at Parkersburg and Williamstown, West Virginia, and Marietta and Coolville, Ohio. The Marietta site has been conveyed to the City of Marietta. An observation platform and picnic facilities have been provided at the locks (Reedsville, Ohio). A riverfront park at Parkersburg was completed in 1982. Visitation in 1997 was 427,000.

The Federal Energy Regulatory Commission (FERC) issued a license to the city of Jackson, Ohio, on 27 September 1989 for construction of a hydropower facility on the abutment site. When completed, the site will contain fishing-access facilities.

Recreation development at the abutment site (West Virginia side of the river) depends on decisions by the Federal Energy Regulatory Commission concerning future development of a hydroelectric plant at that location.

Racine Locks and Dam
West Virginia and Ohio
Huntington District

Racine Locks and Dam is located on the Ohio River downstream from Letart (pop. 100), West Virginia, and Letart Falls (100), Ohio, and replaced three obsolete lock and dam structures. The dam provides a pool with a minimum navigable depth of 9 feet, extending 34 miles to Belleville Locks and Dam. The usable dimensions of the two lock chambers, a main lock and an auxiliary lock located side by side, are 110 feet by 1200 and 110 feet by 600 feet, respectively. The dam is a nonnavigable gated structure with a lift of 22 feet. The estimated Federal cost is $65,900,000. Construction was started in 1964; the project was completed for operation in 1970.

In 1982, Ohio Power Company, under license from the Federal Energy Regulatory Commission, built a hydroelectric power plant at the dam's right abutment (Ohio side). The plant contains two bulb-type turbines, with a total generating capacity of 49,200 kilowatts.

A boat-launching ramp has been built at Ravenswood, and an observation platform and picnic facilities are available at the locks near Letart, West Virginia. In 1984, multipurpose recreation facilities were developed by the Ohio Power Company at the abutment site (in Ohio). Visitation in 1997 was nearly 132,000.

Robert C. Byrd Locks and Dam
Ohio and West Virginia
Huntington District

Robert C. Byrd Locks and Dam , formerly known as the Gallipolis Locks and Dam, is located about 14 miles downstream from the mouth of the Kanawha River. Its pools extends 42 miles up the Ohio to Racine Locks and Dam and takes in 31 miles of the Kanawha River, to Winfield Locks and Dam. The dam is a nonnavigable roller-gated structure.

The original structure was completed in 1937 at a cost of $10,400,000 and was the most modern component of the lock and dam system before the Modernization Program was begun in 1954. It replaced three obsolete locks and dams on the Kanawha River and three on the Ohio River. Improvements at Robert C. Byrd to provide a uniform lockage system throughout the central reach of the Ohio River are complete with a new 1,200-foot main lock and a new 600-foot auxiliary lock in a bypass canal. Lock construction began in November 1987, and the new lock locks were opened for traffic on 30 January 1993.

Construction of a fish hatchery for the West Virginia Department of Natural Resources has begun on the adjacent land. The completed construction will include handicap accessible recreation and nature trails, additional picnic area with shelters, softball field, playground, restrooms, and paved parking. Design is near completion for a fisherman's access on the Ohio side of the river. There are existing picnic facilities located at the lock site on the West Virginia side of the river and a fishing access area on the abutment side. Visitation in 1997 was 87,600.

Greenup Locks and Dam
West Virginia, Ohio and Kentucky
Huntington District

Greenup Locks and Dam, located on the Ohio River downstream from Greenup (pop. 1,130), Kentucky, was placed in operation in 1962 and completed in 1964. The project replaced four obsolete lock and dam structures on the Ohio River and one on the Big Sandy River. It provides a pool with a minimum navigable depth of 9 feet, extending 62 miles upriver to Robert C. Byrd Locks and Dam. All of the important Huntington-Ashland-Ironton harbor area is therefore located within one pool. The two lock chambers are positioned side by side, the main lock 110 feet by 1200 feet in usable dimensions and the auxiliary lock 110 feet by 600 feet. The dam is a nonnavigable gated structure with a lift of 30 feet between normal lower and upper pools.

The total Federal cost was about $55,720,000. Non-Federal funds were contributed for modifications of the substructure so that a two-lane highway bridge could be supported at a future time.

In 1977, a four-party agreement to build the bridge was reached among Ohio, Kentucky, the Federal Highway Administration, and the Corps of Engineers. Construction of the bridge was begun in March 1984. The bridge was dedicated on 31 October 1986 and was opened for traffic on 23 January 1987. The cost of building the bridge, exclusive of approaches, was $10.9 million.

Recreational developments built in conjunction with the project include an observation platform and picnic facilities at the locks site on the Kentucky side of the river, picnic facilities at the abutment site, and eight boat-launching areas at various locations within the navigational pool—two in Huntington, West Virginia, two in Kentucky, and four in Ohio. Fisherman access facilities are available at the abutment end of the dam (in Ohio). Visitation in 1997 was 1,668,600.

The City of Hamilton, Ohio, under license from the Federal Energy Regulatory Commission, operates a hydroelectric power plant at the dam's right abutment (Ohio side). Commercial operation was begun in 1982. The plant has three bulb-type turbines with a total generating capacity of 70,200 kilowatts.

Open-Channel Work
Pittsburgh and Huntington Districts

Open-channel work on the Ohio River includes the removal of obstructive bars and shoal areas within the various navigation pools to maintain a project depth of 9 feet and a minimum navigation channel width of 300 feet as authorized for the present canalization system. The amount of material dredged depends on the amount of sediment deposited during the high-water season.

Open-channel work also includes the construction and maintenance of back-channel dams and dikes and the removal of snags and wrecks.

Local Flood-Protection Projects and Other Improvements

Completed and active Corps of Engineers projects along the Ohio River in West Virginia other than the navigation projects just described are taken up in the following subsections, beginning with the project farthest upstream. Inactive authorized flood-protection projects are then listed in tabular form.

Chester Emergency Bank-Protection Project Neptune Avenue
Pittsburgh District

Stone bank protection has been provided along a 1200-foot reach of the left bank of the Ohio River in Chester (pop. 2,777), Hancock County, West Virginia, under authority of Section 14 of the Flood Control Act of 1946. The work was completed in December 1983 at a Federal cost of $133,00 and provides protection to a section of Neptune Avenue.

Colliers Snagging and Clearing Project
Pittsburgh District

A snagging and clearing project was completed in 1955 on Harmon Creek, in Brooke County, West Virginia, under authority of Section 2 of the Flood Control Act of 1937. The project, about 3.5 miles southeast of Weirton (pop. 21,917), West Virginia, extends through the unincorporated community of Colliers (600), West Virginia. The work consisted of about 5,000 feet of channel excavation and clearing, and has materially reduced the damage resulting from major floods and has eliminated or reduced to normal amounts the damage resulting from lesser floods. The cost of the project was $27,700.

Hooverson Heights Emergency Bank-Protection Project
Pittsburgh District

Stone protection has been provided along a 190-foot reach of the left bank of the Ohio River for the protection of the Hooversen Heights Public Service District water-treatment plant, located within the corporate limits of Follansbee (pop. 3,398), West Virginia. The project was built under authority of Section 14 of the Flood Control Act of 1946. The project was completed in February 1987 at a Federal cost of $175,800.

Wellsburg Emergency Bank-Protection Project
Pittsburgh District

Studies have been completed under authority of the Supplemental Appropriations Act of 1987 (PL 100-71), which directed the Corps of Engineers to provide riverbank protection at four locations along the left bank of the Ohio River at Wellsburg. The projects involved the placement of stone on the riverbank as follows: (1) 1200-foot reach at the "Main Street area," (2) a 400-foot reach at the "Water Works area," (3) a 700-foot reach at the "Middle School area," and (4) a 600-foot reach at the "Cox Run area." The project has since been completed, with the City of Wellsburg acting as the local sponsor.

The projects were completed in July 1993 at a cost of $549,837.

Warwood Emergency Bank-Protection Project
Pittsburgh District

Construction under authority of Section 14 of the Flood Control Act of 1946 was completed in 1979 for the protection of a sanitary-sewer interceptor line at Warwood, located in the northern portion of Wheeling (pop. 33,959), West Virginia. Previous fill was provided for the eroded areas and stone protection placed over a graded filter material. The total Federal cost was $117,700.

Glen Dale Emergency Bank-Protection Project
Pittsburgh District

A study has been completed under authority of the Supplemental Appropriations Act of 1987 (PL 100-71), which directed the Corps of Engineers to provide riverbank protection along the left bank of the Ohio River in Glen Dale. The proposed project would involve the placement of stone along a 170-foot reach of riverbank to protect two city-owned sewer outfalls at two locations. The proposed project would involve the placement of stone along a 170-foot reach of riverbank in two locations to protect two separate city-owned sewer outfalls.

The project was completed in December 1991 at a cost of $101,800.

Sistersville Emergency Bank-Protection Project
Huntington District

The placement of stone riprap along the Ohio River at Sistersville (pop. 1,821), river mile 137.5, was completed in December 1980 under authority of Section 14 of the Flood Control Act of 1946. Protection is provided for a sanitary sewer and a raw-water intake facility. The cost of the project was about $17,000.

Williamstown Emergency Bank-Protection Project
Huntington District

The initial phase (a 340-foot reach) of the placement of stone riprap along the Ohio River at Williamstown (pop. 2,813) at about river mile 172.5 was completed in December 1983 under authority of Section 14 of the Flood Control Act of 1946. Protection is provided for a sanitary-sewer main interceptor along the riverbank. The completed work was accepted by the City as non-Federal sponsor in February 1984. The cost of the work was about $65,000.

Construction work for the second phase of the project (a 460-foot reach), located both downriver and upriver of the initial project, was completed and accepted by the City in October 1988. The cost of the work was about $81,000.

Parkersburg Local Flood-Protection Project
Huntington District

Parkersburg (pop. 33,431) is located at the confluence of the Ohio River and Little Kanawha River, in Wood County. The city has a flood-protection system that provided partial protection during the February flood. The system was built under authority of the Flood Control Act of 1938 and has been in operation since 1950. The system includes 2 miles of concrete wall and 1.8 miles of earth levee, 14 gated traffic openings, six pump stations for the disposal of interior drainage and sewage during flood periods, associated drainage structures, and 1900 feet of diversion channel for Pond Run. About 720 acres is protected.

The works are designed to withhold floods equal to the March 1913 maximum of record. This protection is supplemented by a coordinated system of reservoirs on Ohio River tributaries above Parkersburg. Through fiscal year 1997, the project has prevented and estimated $83,387,000 in flood damage.

The Federal share of the total cost of $6,953,000 was $6,653,000. The remaining $300,000 was the local share. The project was completed and transferred to the City for operation and maintenance in 1950.

Parkersburg Emergency Bank-Protection Project
Huntington District

A bank-protection project at Parkersburg (pop. 33,431) was approved in 1978 under authority of Section 14 of the Flood Control Act of 1946. Construction was completed in June 1982 and accepted by the city. The protection measures, consisting of stone riprap, were designed to prevent further bank failure and erosion from affecting the city's water wells, located on Neal Island and the nearby main riverbank. The cost of the project was about $163,000.

New Haven Emergency Bank-Protection Project
Huntington District

A bank protection project at New Haven (pop. 1,667) was approved in 1972 under authority of Section 14 of the Flood Control Act of 1946. Revisions were approved in December 1977 because of worsening conditions. The recommended plan provided riprap protection on the left descending bank of the Ohio River to prevent further bank erosion in the vicinity of the outfall from the New Haven sewage-treatment plant, river mile 245.0, Mason County. Construction was completed in 1982.

Point Pleasant Local Flood-Protection Project
Huntington District

The Point Pleasant (pop. 5,002) local flood-protection project, built under authority of the Flood Control Act of 1938, is located in Mason County at the confluence of the Ohio and Kanawha rivers. It comprises a system of works including about 1.4 miles of concrete wall and 0.9 mile of earth levee, 15 gate openings and one ramp to meet traffic requirements during normal non-flood periods, three pump stations to dispose of sewage and drainage during floods, and 2400 feet of diversion channel. About 250 acres is protected.

The works acting alone afford protection against a flood stage as great as the January 1937 maximum of record. They're supplemented by a coordinated system of reservoirs in the Ohio River basin above Point Pleasant. Together, the reservoirs and local works provide protection against floods greater than any previously experienced.

The Federal portion of project costs was $2,920,000, with local costs estimated at $278,000 and total project costs at $3,198,000. Local interests accepted the completed works in 1951 for operation and maintenance. Through fiscal year 1997, some $35,099,000 in flood damage has been prevented.

Point Pleasant State Park Emergency Bank-Protection Project
Huntington District

In April 1989, project construction was initiated in support of a stone retaining wall that serves as a riverward perimeter marker for Point Pleasant State Park. At that time the wall was endangered by riverbank erosion along the right descending bank of the Kanawha River at its confluence with the Ohio River. Project construction was completed in May 1989. Total project costs were $98,466 ($77,421 Federal, $21,045 non-Federal). Non-Federal sponsors for this project were the West Virginia Department of Natural Resources and Department of Commerce.

Huntington Local Flood-Protection Project
Huntington District

The Huntington (pop. 54,623) local flood-protection system is located along the Ohio and Guyandotte rivers at Huntington, in Cabell and Wayne counties. It was built under authority of the Flood Control Acts of 1937 and 1938. Principal elements of the protection works are 7 miles of concrete walls and 4.5 miles of earth levees, 17 pump stations disposing interior drainage and sewage during floods, and 45 gated traffic openings through the works. The designed protection is typical of other Ohio River local flood-protection projects, consisting of direct protection for flood stages as great as the January 1937 maximum of record, supplemented by the coordinated flood-control reservoir system on upstream Ohio River tributaries.

The project was completed in 1943, but was significantly advanced so that partial flood protection was provided by emergency operation as early as 1940. Flood damage prevented through 1997 is valued at an estimated $231,345,000 far exceeds total project first cost of $8,682,000. Of the total cost, $1,510,000 was the local

share. Operation and maintenance have been carried out by the City since transfer of the project to local authorities in 1943.

Huntington Local Flood-Protection Project Emergency Repairs
Huntington District

Subsidence and void areas were detected along the landward side of part of the floodwall in the Guyandotte section of the Huntington local flood-protection project. The Corps of Engineers cooperated with the City in accomplishing corrective work in the spring of 1973 to ensure contained stability of the protective system. Corps participation was pursuant to the emergency repair and rehabilitation authority provided by Public Law 84-99. Total cost of the effort was $215,700.

Huntington Public Access Site and Riverfront Park
Huntington District

Riverfront recreational development at Huntington has involved cost-sharing with the city. The overall facilities were built in two phases. Phase 1, including boat ramps, parking areas, and a restroom, was completed in 1978. Phase 2, the David W. Harris Riverfront Park, completed in December 1984, includes a riverfront walkway, extensive outdoor seating areas, and day-use areas.

The project was undertaken under authority of the Flood Control Act of 1944, as amended, with cost sharing provided under the Water Projects Recreation Act of 1965. The overall cost was more than $2,000,000. Visitation during 1997 was estimated at 370,000.

The expansion of the David W. Harris Riverfront park which covers approximately 5 acres downstream of the existing facility, was completed in 1997. Major project features include a docking area for large rivercraft, 300-feet of additional docking for fishing or mooring of small vessels, visitors overlook accessed by a paved road and parking, and an additional restroom facility.

Fourpole Creek Snagging and Clearing Project
Huntington District

Protective measures along 2.6 miles of Fourpole Creek at Huntington, in Cabell County, were carried out in 1953 under authority of Section 2 of the Flood Control Act of 1937, as amended. The work accomplished included clearing, snagging, and straightening the channel, the reconstruction of two bridges, tree removal, and the relocation and alteration of utility lines. The improvement provides a substantial degree of protection against most floods and greatly reduces the frequency and volume of overbank flooding. Considerable flood damage will result, however, in the event of extreme flooding caused, for example, by intense local rainfall. The project cost was $100,000, half of which was paid by the Federal Government.

Ceredo-Kenova Local Flood-Protection Project
Huntington District

The contiguous municipalities of Ceredo (pop. 1,921) and Kenova (3,731) are located on the Ohio River in Wayne County. Kenova is located at the confluence of the Big Sandy River with the Ohio; Ceredo adjoins the lower course of Twelvepole Creek. Flood-protection works for these communities, built under authority of the Flood Control Act of 1938, include about 2.6 miles of earth levee, 1.6 miles of concrete wall, six pump stations for disposing of sewage and drainage from within the protected area during flood periods, and two traffic ramps and 27 gated openings through the works to permit unobstructed movement of traffic during normal river conditions. About 710 acres is protected.

The works are designed to protect the communities against a flood equal to the January 1937 maximum of record and are supplemented by a coordinated system of reservoirs on Ohio River tributaries located in the project area.

The project was completed in 1940 at a total first cost of $3,022,000, of which the Federal share was $2,757,000 and the local share $265,000. Initial flood-control benefits were realized during the flood of December 1942; an estimated $54,835,000 in cumulative damage was prevented through 1997. Operation and maintenance of the project have been accomplished by local interests since 1944 when the project was transferred to them.

Inactive Authorized Flood-Protection Projects

Two local flood-protection projects along the Ohio River in West Virginia, authorized under the Flood Control Act of 1938, remain in the inactive authorized category: Benwood (pop. 1,630), a downstream suburb of Wheeling (pop. 33,959); and Woodlands, an unincorporated community some 20 miles below Wheeling.

Planning Studies

The following have been authorized planning studies for the Ohio River and for locations along the Ohio River in West Virginia.

Ohio River Main-Stem Study
Pennsylvania, Ohio, Indiana, Illinois, West Virginia, and Kentucky
Pittsburgh, Huntington, and Louisville Districts

Under the direction of the Corps of Engineer's Ohio River Division, Pittsburgh, Huntington, and Louisville districts

are conducting a comprehensive study of the main stem of the Ohio River. The study area covers the entire 981-mile length of the Ohio River, from Pittsburgh to Cairo, canalized for 9-foot barge navigation by a series of 20 lock and dam structures.

Authorization for the study stems from a resolution adopted in May 1955 by the Senate Committee on Public Works. The latest of subsequent resolutions supporting the study was adopted in March 1982.

The primary objectives of the study are (1) to evaluate the modernization of the existing navigation facilities; (2) to assess the system impacts and potential from hydropower development at the existing navigation dams; (3) to investigate main stem local flood-protection projects; and (4) to evaluate the flood-damage potential at unprotected locations along the Ohio River main stem.

Within the Ohio River basin, the Ohio River main stem represents an exceptional concentration of urban, commercial, and industrial development. Two Consolidated Metropolitan Statistical Areas are recognized along the river, centering at Pittsburgh (mile 0) and Cincinnati (mile 470). Each of these comprises two Primary Metropolitan Statistical Areas. In addition, seven other Metropolitan Statistical Areas border the river: Steubenville-Weirton, Wheeling, Parkersburg-Marietta, Huntington-Ashland-Ironton, Louisville, Owensboro, and Evansville, which is at mile 792.

Ohio River Public Port Studies

Huntington District

Underway

Funds were included in both the FY 1995 and 1996 Energy and Water Resources Development Appropriation Acts for preparation of feasibility studies of the Ohio River between river miles 40.0 and 317.0 to determine the development potential of public ports. A reconnaissance level study was completed in 1993 that identified several public port sites along the Ohio River in West Virginia. The West Virginia Public Port Authority, as the sponsoring agency of the current studies, is interested in development of public ports along the Ohio River to act as a catalyst for new industrial development and to provide intermodal and multi-modal opportunities for movement of commodities produced in West Virginia. The Huntington District has completed feasibility master plan studies for the Cabell/Wayne Port District, the Erickson/Wood County Port District, the Jackson County Maritime and Industrial Centre, and the Weirton Port and Industrial Centre. The Buffalo/Putnam County Port District feasibility master plan will be initiated in November 1998. Each of the feasibility master plans evaluates the physical, environmental, and socioeconomic feasibility of individual port sites within the context of defined state and regional transportation and commodity markets.

West Virginia Comprehensive Study

Huntington and Pittsburgh Districts

The West Virginia Comprehensive Study was authorized by Resolution adopted 8 September 1988 by the House of Representatives Committee on Public Works and Transportation. The Study will consist of that portion of Western West Virginia bordering on the Ohio River. The area would extend from Ohio River mile 40 to river mile 317 and include the shoreline and adjacent floodplains of the 12 West Virginia counties contiguous to the Ohio River. The study area will include all embayments, mouths of tributaries, and--where appropriate and pertinent--the adjacent areas up to ridges and hilltops. Full consideration will be given to the expansion of economic base development associated with the waterway and to opportunities for preventing flood damage. Measures for preventing flood damage will be limited to areas along the Ohio River. The first, or reconnaissance, phase of the study was completed in late 1992.

Section 14 Project Ohio River Sewer Main Huntington, West Virginia

Huntington District

Underway

The Ohio River Sewer Main Section 14 Project Design Analysis was initiated in 1997, pursuant to the authority of Section 14 of the Flood Control Act of 1946.

Flood events of January of 1996 and 1997 have caused extensive additional bank failure and erosion and top of bank retreat adjacent to the City Sewer Main for Huntington West Virginia. Four sewer outfalls and manholes are endangered and could be breached. Users include 18,000 households, commercial establishments, and large industrial complexes within Eastern Huntington. Breaching would result in the discharge of untreated sewage at and immediately up river from the raw water intake for the City of Huntington. Breaching would also cause extensive environmental damages.

A Planning and Design Analysis has been completed for this potential project. The recommended plan for protecting this sewer main consists of placing COE ten inch top size stone to stable geometries to form a longitudinal dike adjacent to the river bank. The area of protection is approximately 800 feet.

The City of Huntington has requested help with this Section 14 project to protect this City Sewer Main. A Letter of Intent, dated 24 October 1997 has been received requesting the Corps of Engineers help. The Huntington District is presently awaiting concurrence from the City of Huntington on the proposed size and cost of the project. Once concurrence has been received, a request for project construction funds will be made to the Corps of Engineers Division office in Cincinnati Ohio.

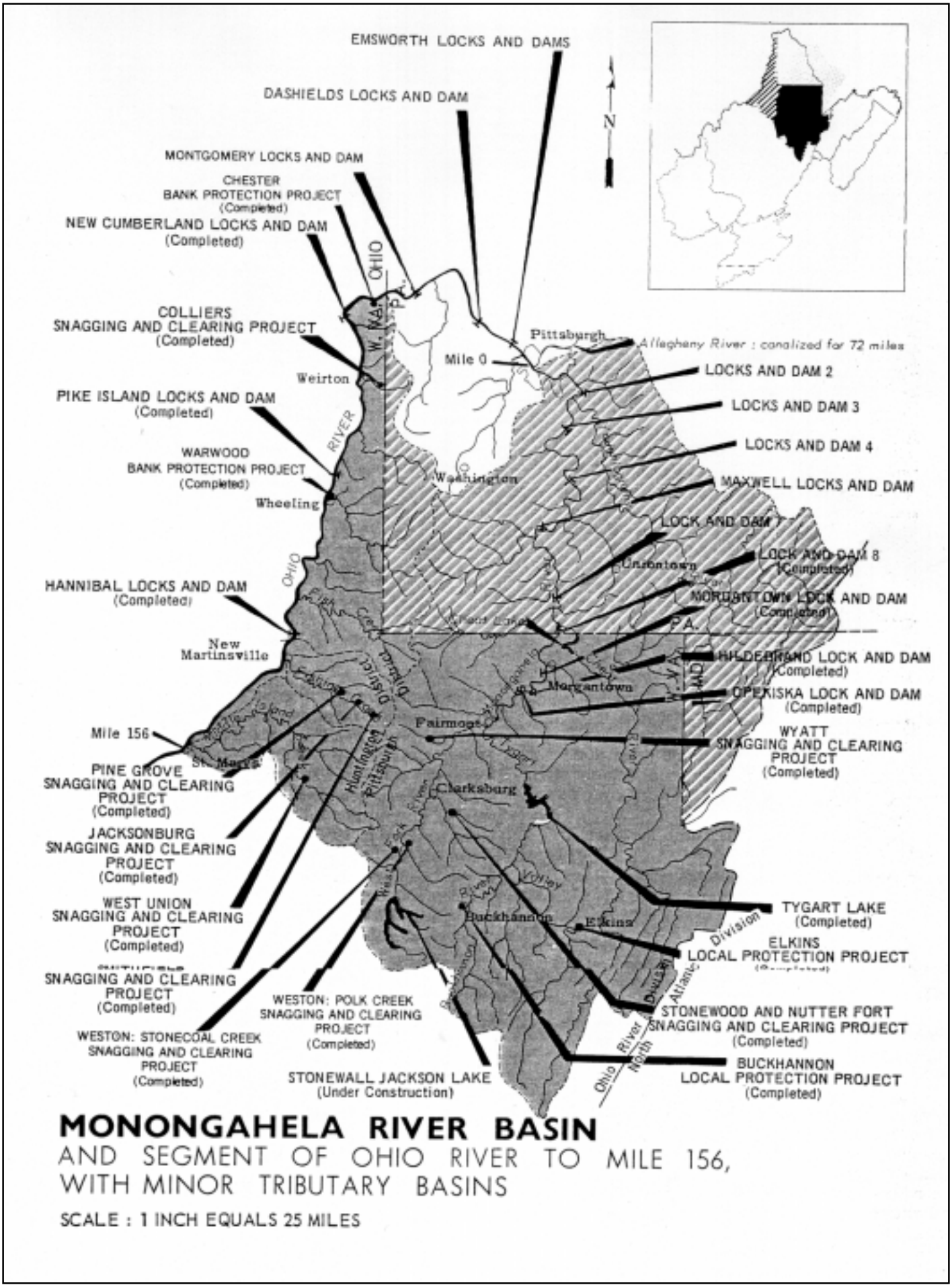
Floodplain-Information Studies

Reports of floodplain-information studies for locations along the Ohio River in West Virginia, together with their years of completion, are listed in the following table. The reports, covering a number of counties and two small areas, are arranged in the geographical order of their study area, beginning upriver.

Reports of Floodplain Information Studies (Ohio River in West Virginia)

Study Area	Reports of Publication
Pittsburgh District	
Hancock County	1971
Brooke County	1971
Ohio County:	
Ohio River and Wheeling Creek	1971
Little Wheeling Creek: Triadelphia to Valley Grove	1970
Marshall County	1971
Wetzel County	1971
Huntington District	
Tyler County	1974
Pleasants County	1974
Wood County	1974
Jackson County	1974
Mason County	1974
Cabell and Wayne Counties	1973

For the latest flood-hazard information, refer to the community published "Flood-Hazard Maps" issued by the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program. Copies of these maps are distributed to all community administrative offices for local implementation and general reference use by the public. For assistance, call the respective community, West Virginia Department of Natural Resources at (304) 256-6850, West Virginia Office of Emergency Services at (304) 348-5380, or the respective Corps District office for Floodplain Management Services.



MONONGAHELA RIVER BASIN

AND SEGMENT OF OHIO RIVER TO MILE 156,
WITH MINOR TRIBUTARY BASINS

SCALE : 1 INCH EQUALS 25 MILES

Monongahela River Basin

Description of Area

The Monongahela River basin has a drainage area of 7,378 square miles—4,624 square miles in West Virginia, 2,316 square miles in Pennsylvania, and 438 square miles in Maryland. The basin is contained in the dissected Appalachian plateaus, the eastern portion showing mountainous characteristics.

The Monongahela River is formed by the confluence of Tygart Valley River and West Fork River at Fairmont (pop. 20,091), in Marion County, West Virginia. It follows a northerly course to its junction with its major tributary, the Youghiogheny River, several miles above Pittsburgh (350,353). From there it flows to its junction with the Allegheny River at The Point in Pittsburgh to form the Ohio. The Cheat River, whose drainage area is mainly in West Virginia, joins the Monongahela within the Pennsylvania border.

The basin's population in 1980 was 1,450,000, the greatest concentration being located in the urbanized area at and near Pittsburgh. Economically, much of the basin still heavily depends on resource extraction, especially coal, but manufacturing and service-oriented activities are of major importance.

Status of Corps Work

The Monongahela River basin in West Virginia contains 12 completed Corps of Engineers water-resource projects, four of which are on the Monongahela River navigation system. Of the lake projects, two are completed and one is in the inactive-authorized category. Two local flood-protection projects and four snagging-and-clearing projects have also been completed. Two emergency bank-protection projects are under construction.

Two planning studies are concerned with the basin in West Virginia.

Five floodplain-information studies have been completed.

Monongahela River Navigation System

Pennsylvania and West Virginia
Pittsburgh District

The navigation system on the Monongahela River provides for the improvement of the river throughout its entire 128-mile length, from Fairmont, West Virginia, to Pittsburgh, Pennsylvania, by means of a series of locks and dams that provides a minimum navigable depth of 9 feet.

Monongahela Navigation System (1994)

Lock/Dam Designation	Number of Lock Chambers	Lock Sizes (in Feet)	Type of Dam	Date of Construction*
2	2	110 x 720 56 x 360	Fixed Crest	1953
3	2	56 x 720 56 x 360	Fixed Crest	1980
4	2	56 x 720 56 x 360	Gated	1967
Maxwell	2	84 x 720 84 x 720	Gated	1965
7	1	56 x 360	Fixed Crest	1925
Grays Landing	1	84 x 720	Fixed Crest	1993
Point Marion	1	84 x 720	Gated	1994
Morgantown	1	84 x 600	Gated	1950
Hildebrand	1	84 x 600	Gated	1960
Opekiska	1	84 x 600	Gated	1967

* Or reconstruction. See text.

Federal interest in the river began in 1872 with the construction of two lock and dam projects on the upper river. This interest was renewed in 1896 with authorization for the acquisition of the original seven locks and dams constructed on the lower river by the Monongahela Navigation Company. The Monongahela system now comprises the following structures, listed in order, proceeding from Pittsburgh upstream:

Locks and Dam 2 was placed in operation in 1906. The locks were replaced in 1953, but the original dam remains. The dam was authorized for replacement with a gated dam as part of the Lower Mon Improvement Project.

Locks and Dam 3 was placed in operation in 1907 and included two 56-foot x 360-foot lock chambers. The landward chamber was extended to 720-feet in 1923-1924. The project was rehabilitated in 1978-1980; it is authorized to be removed as part of the Lower Mon Improvement Project.

Locks and Dam 4 was placed in operation in 1932. The dam was replaced in 1967 to accommodate pool changes associated with the construction of Maxwell Locks and Dam. The locks are authorized for enlargement to dimensions of 84-feet x 720-feet as part of the Lower Mon Improvement Project.

Morgantown Lock and Dam was placed in operation in 1950; Hildebrand in 1960; and Opekiska in 1967. Further details regarding these three uppermost Monongahela River projects are provided below.

Point Marion Lock and Dam (Formerly L/D 8)
Pennsylvania and West Virginia
Pittsburgh District

Point Marion Lock and Dam, built under authority of Supplemental Appropriations Act of 1985 for Engineering and Design and Land Acquisition, and Water Resources Development Act of 1986, 99th Congress dated 13 November 1986 (Public Law 99-662) for construction of a new lock. Alteration of the dam in order to provide a movable crest was authorized under the River and Harbors Act dated 17 May 1950.

The lock chamber is 84 feet by 720 feet. The cost of construction was about $101.9 million.

Morgantown Lock and Dam
Pittsburgh District

Morgantown Lock and Dam, built under authority of the River and Harbor Act of 1909, is located in Monongalia County near Morgantown (pop. 26,537), West Virginia. The structure was completed in 1950. The concrete dam is 410 feet long and has six tainter gates, each 60 feet long. It provides a 9-foot navigation channel to Hildebrand Lock and Dam. The lock is 84 feet by 600 feet and has a lift of 17 feet between normal pool. The cost of the project was almost $9 million.

Hildebrand Lock and Dam
Pittsburgh District

Hildebrand Lock and Dam, in Monongalia County, West Virginia, was built under authority of the River and Harbor Act of 1950. It was placed in operation in 1959. The concrete dam is 530 feet long, with a fixed-weir section on each end and six tainter gates—each 60 feet long in the center section. It provides a 9-foot channel to the Opekiska Lock and Dam. The lock is 84 feet by 600 feet and has a lift of 21 feet between normal pools. The cost of the project was about $12.5 million.

Opekiska Lock and Dam
Pittsburgh District

Opekiska Lock and Dam was completed in 1967 under authority of the River and Harbor Act of 1950. The project extends the 9-foot navigation channel to the head of the Monongahela River at river mile 128.7. The nonnavigable gated dam is 366 feet long, with four gated sections, each 84 feet long. The lock is a single chamber, 84 feet by 600 feet, with a normal lift of 22 feet. The cost of the project was about $25.2 million.

Clarksburg Emergency Bank-Protection Project
Pittsburgh District

Stone protection was provided along a 200-foot reach of the right bank of Elk Creek for the protection of Sandy Boulevard in Clarksburg (pop. 17,762), West Virginia. The project was developed under authority of Section 14 of the Flood Control Act of 1946. The project was completed in January 1987 at a Federal cost of $95,200.

Granville Emergency Bank-Protection Project
Pittsburgh District

Stone protection was provided along a 500-foot reach of the left bank of the Monongahela River for the protection of West Virginia Route 100 in Granville (pop. 823), West Virginia. The project, constructed under Section 14 of the Flood Control Act of 1946, was completed in January 1987 at a Federal cost of $213,200.

West Fork River Basin Projects

Stonewall Jackson Lake
Pittsburgh District

Stonewall Jackson Lake, authorized by the Flood Control Act of 1966, Public Law 89-789, is located on the West Fork River, a formation stream of the Monongahela River. The project's purposes include flood control, water-quality control, water supply, and recreation.

The dam is located about 3 miles upstream of Weston, West Virginia, and 73 miles above Fairmont, West Virginia, where the West Fork and Tygart Valley rivers join to form the Monongahela. The lake is contained entirely within Lewis County.

The dam is of the concrete gravity type. The crest is 620 feet long and stands 95 feet above the streambed. The dam is provided with low-level and water-quality sluices and an uncontrolled spillway.

The gross storage capacity is 74,650 acre-feet, including 45,050 acre-feet allocated for water-quality control, future water supply, and recreation use; 26,480 acre-feet (summer) and 38,550 acre-feet (winter) for flood control; and 3,120 acre-feet for permanent storage. Project cost was $215 million.

Major flood-control benefits have been realized in the floodplains of the West Fork and upper Monongahela rivers. The natural streamflow will be augmented during periods of low flow, providing improved water quality beneficial to points downstream on the West Fork River, the Monongahela throughout its length, and, to a minor extent, the upper Ohio.

The basic recreation facilities for the state park were completed in 1991. Reservoir storage will be used to meet future water-supply needs for Weston. The project through September 1994 has prevented an estimated $46,769,000 in flood damage.

Weston: Stonecoal Creek Snagging and Clearing Project
Pittsburgh District

The Stonecoal Creek Project at Weston (pop. 4,926), West Virginia, in Lewis County, was completed in 1960, under authority of Section 208 of the Flood Control Act of 1954. It consisted of clearing, snagging, and deepening the channel of Stonecoal Creek for 5,600 feet above its junction with the West Fork River. The channel improvements will cause a 1-foot reduction in flood stage through the improved reach of channel. Federal and non-Federal costs were $51,700 and $11,000, respectively.

Weston: Polk Creek Snagging and Clearing Project
Pittsburgh District

The Polk Creek Project, completed under authority of Section 2 of the Flood Control Act of 1937, consisted of clearing and straightening the channel of the lower reach of Polk Creek in Weston, West Virginia, and the diversion of the creek to the West Fork River at a point about 2,000 feet below the former mouth. Construction was carried out in 1953 at a Federal cost of $42,800.

Wyatt Snagging and Clearing Project
Pittsburgh District

The Wyatt Project, which extends through the village of Wyatt (pop. 100), is on Bigamon Creek on the north edge of Harrison County, about 10 miles above its junction with the West Fork River. The project was carried out under authority of Section 2 of the Flood Control Act of 1937. The work included about 1,000 feet of new cutoff channel, the improvement of about 350 feet of old channel, and the placement of part of the excavated material in the old creek channel to form a barrier against flow around the loop on which Wyatt is located. Construction was completed in 1953, at a Federal cost of $24,700. The improvement protects Wyatt against small floods, which occur on an average of two or three times annually, and provides limited protection against larger floods.

Stonewood and Nutter Fork Snagging and Clearing Project
Pittsburgh District

The Stonewood and Nutter Fork snagging and clearing project extends 8,740 feet along Elk Creek at Clarksburg (pop. 17,762), West Virginia. It was completed in 1959 under authority of Section 208 of the Flood Control Act of 1954. It consisted of bank clearing and the removal of bars, shoals, loose rock, and other material from the streambed. Federal cost of the project was $66,500.

Tygart Valley River Basin Projects

Tygart Lake
Pittsburgh District

Tygart Lake is in the Monongahela River basin, on Tygart Valley River, in Taylor and Barbour counties. The dam is about 2 miles above Grafton (pop. 5,549), West Virginia, in Taylor County. It was completed in 1938, and has been operated and maintained by the Corps of Engineers since that time. The project controls the runoff from a drainage area of 1,184 square miles.

The lake, authorized under the River and Harbor Act of 1935, is operated for the purpose of ensuring an adequate navigation water supply in the Monongahela and Ohio River valleys. Important secondary functions resulting from reservoir operations include the improvement of domestic and industrial water supplies, reductions in the damage caused by acid mine wastes, and the reduction of organic pollution.

Except for the Federal administration area in the vicinity of the dam, the development of recreational facilities and the management of the fish and game resources in the Government-owned part of the Tygart Lake area are the responsibility of the State under a long-term agreement with the Department of the Army. The leased land, together with the various parcels of State-owned land adjoining the reservoir area, are known as Tygart Lake State Park and Pleasant Creek Hunting Area. The state park, because of the large summer pool, clean water, and scenic setting, has become one of the state's more popular recreation centers. Visitation to the area in 1993 numbered about 457,700. The State continues to develop park facilities, including cabins, within the reservoir area and on adjoining State-owned land.

The cost of the project was $18 million. The estimated total savings in prevented flood damage through 1994 is an impressive $556,331,000.

The concrete gravity-type dam is 1,921 feet long at the top and rises 230 feet above the riverbed. Two penstocks are contained in the dam for the possible future generation of hydroelectric power.

A minimum pool is provided with a storage capacity of 9,700 acre-feet and an area of 620 acres. A storage capacity of 99,900 acre-feet is reserved for the storage of excess runoff during the spring months for releases during low rainfall periods to make up the deficiency of water in the Monongahela River. At full capacity the low-flow regulation pool covers 1,740 acres. Storage capacity ranging from 178,100 acre-feet in summer to 278,000 acre-feet in winter is available for the storage of flood runoff. The lake covers an area of 3,430 acres at spillway level. Gross controlled storage is 287,700 acre-feet at that level.

Elkins Local Flood-Protection Project
Pittsburgh District

Elkins (pop. 7,692), West Virginia, is in Randolph County, on the Tygart Valley River about 75 miles above its mouth. The principal elements of the Elkins protection project are a cutoff channel and dikes, located about 1.5 miles above the city, which divert flood flows from the loop of the Tygart Valley River on which Elkins is located. During flood periods, storage for interior drainage is provided in the channel of the protected loop of the river. During non-flood periods, inlet and outlet works in the dikes permit the passage of small flows; a small pondage basin provided above the upstream diversion dike is operated to improve low-flow conditions.

The project provides complete protection for Elkins against the maximum flood of reasonable expectancy, which would substantially exceed any flood of record. The protected area comprises about 525 acres.

The total project cost was $1,173,000, including a local share estimated at $40,000. The diversion channel is maintained at Federal expense, but local interests operate and maintain the remainder of the project. Since its completion in 1949, the project has prevented $15,373,000 in flood damage.

Buckhannon Local Flood-Protection Project
Pittsburgh District

The Buckhannon flood-protection project, completed in 1969, is on the Buckhannon River near Buckhannon (pop. 6,122), West Virginia, in Upshur County. The improvement, authorized by the Flood Control Act of 1962, is 4.6 miles long and involved deepening, widening, and uniformly aligning the river channel. Combined with a channel cutoff is an enlargement of an existing raceway across the neck of a U-loop in the river. The project will reduce the flood of record by about 3 feet. The Federal and non-Federal costs of the project were $1,570,000 and $75,000, respectively. Through September 1994, the estimated savings in prevented flood damage since the project was completed in 1969 is $6,439,000.

Cheat River Basin Project

Rowlesburg Lake
Pittsburgh District
Inactive Authorized

Rowlesburg Lake was authorized by the Flood Control Act of 1965 to be located on Cheat River, a tributary of the Monongahela River, at the upstream limits of Rowlesburg (pop. 659), West Virginia, in Preston County. The reservoir full pool would extend upstream to Parsons (1,483), West Virginia, in Tucker County.

The project was designed for multipurpose development, including flood control, water-quality control, storage for hydroelectric power production, general recreation, and fish and wildlife conservation.

In a letter dated 9 November 1977, Governor Jay Rockefeller asked that planning on the Rowlesburg Lake project be terminated. In light of this position, Pittsburgh District recommended that the project be reclassified from active to inactive. The inactive status was approved by the Office of the Chief of Engineers on 9 January 1978.

The Monongahela River basin flooding in November 1985 stimulated renewed interest, and numerous requests were received from Congressional, State, and local interests to reactivate the Rowlesburg Lake Study. The Governor of West Virginia specifically requested by letter that the project be returned to an active status, and the Chief of Engineers subsequently agreed to the reclassification. Restudy funds have not been provided, however, and no work is now scheduled.

Planning Studies

Monongahela River Basin Studies
Pittsburgh District

Tygart River Basin, West Virginia.

Pleasant Creek, Section 1135 Wetland.
The Pittsburgh District, under the authority of Section 1135 of the Water Resources Development Act of 1986, is proposing to construct an environmental restoration project on Pleasant Creek near Grafton, West Virginia. Pleasant Creek is a tributary to the pool created by the District's Tygart Lake Dam. The proposed wetland will be located on Federally-owned property currently licensed to the State of West Virginia for wildlife management. Wetlands are scarce within the Tygart Lake project because of steep topography and severe pool fluctuations associated with normal project operations. The project, to be cost shared with West Virginia, will consist of constructing a self-regulating, porous limestone check weir strategically placed across Pleasant Creek. The limestone check weir will create approximately 29 acres of high quality wetlands that will be especially beneficial to waterfowl. Project construction is anticipated for the summer of 1999.

Tygart River Basin, West Virginia Ecosystem Restoration.
A reconnaissance study that investigated ecosystem degradation due to acid mine drainage pollution and potential restoration opportunities in three sub-watersheds of the Tygart basin was completed by the Corps of Engineers in 1997. The three sub-watersheds are Fords Run, Sandy Creek, and Three Fork Creek. The study proposed Corps projects along Maple Run, a tributary of Sandy Creek, and at Fords Run. Follow-up feasibility studies that could lead to project

implementation will be initiated in Fiscal Year 1999 if the Corps and the West Virginia Division of Environmental Protection execute a feasibility study cost-sharing agreement.

Section 581 Studies at Belington and Philippi, West Virginia.

Section 581 of the Water Resources Development Act of 1996 authorized the Corps of Engineers to design and construct flood control measures in the Cheat and Tygart basins that would provide a minimum 100-year level of protection. Belington and Philippi, West Virginia (Tygart basin) were listed as priority communities for carrying out the section. Projects may be recommended without regard to benefit cost-ratio. Funding to initiate preconstruction engineering and design (PED) activities was provided in the Fiscal Year 1998 Energy and Water Development Appropriations Act. As the first phase of PED, detailed project studies at each community are expected to be initiated early in Fiscal Year 1999 to identify the least-cost plan that provides the targeted protection. The least-cost plans will likely include both structural and nonstructural components. Approval of the best plan could lead to the preparation of plans and specifications and construction. Other communities in the Cheat and Tygart basins could be candidates for Section 581 studies and projects in the future.

Monongahela River, West Virginia.

Comprehensive Study.

A reconnaissance study of flooding and other water-related problems as well as opportunities for enhancing urban waterfront areas is being conducted in accordance with the 1994 Energy and Water Development Appropriations Act (PL 103-162).

The Monongahela River, West Virginia, Comprehensive Study is separated into three interrelated study components. These components consist of preparation of conceptual plans for eight specific sites, completion of a riverfront inventory of existing and potential waterfront land uses, and the completion of a side-scan sonar survey of the river itself. Combined, these components will provide an overall master plan and reference tool for future development and regulation within the valley.

As part of the study, non-Federal Governmental entities will be identified who are willing to share the cost of follow-up efforts.

Funding in the amount of $600,000 has been allocated through the 1994 Energy and Water Development Appropriations Act. The reconnaissance report was completed in September.

Cheat River Basin, West Virginia.

A reconnaissance study of flooding and other water-resource-related problems and opportunities in the Cheat River basin is being conducted in accordance with the Energy and Water Development Appropriations Act, 1995 (Public Law 103-316).

Cheat River Basin, Flood Warning System.

The Fiscal Year 1997 Energy and Water Development Appropriations Act provided $500,000 and directed the Corps of Engineers to design and implement, at full Federal expense, a flood warning system for the Cheat River basin. The system was completed in March 1998 and is considered to be state-of-the-art. It involved installation of new and upgraded stream and precipitation gages and radio repeaters, and provision of dedicated computer workstations equipped with flood forecasting software to county emergency management offices. These items were integrated with the existing National Weather Service's Integrated Flood Observing and Warning System (IFLOWS) to form a wide-area network of gages with enhanced communication to the computers by radio, microwave, satellite, and telephone. County emergency management personnel have the capability to interrogate the real-time rain and stream gage information and estimate flood peaks and times so that additional warning times of two to eight hours are possible, depending on location within the basin. The State of West Virginia and the National Weather Service will maintain portions of the flood-warning system.

Cheat River Basin Reconnaissance Study

The study was a reconnaissance level study of alternative measures to reduce flood damages in the Cheat River basin and to identify environmental restoration projects related to acid mine drainage. The study was completed in November 1995. The study evaluated local flood protection projects at Parsons, Hambleton, Hendricks, Rowlesburg, and Camp Dawson, and a system of three dry dams situated on Shavers Fork, Dry Fork, and on the Cheat River main stem at Erwin. Four other dry dam reservoirs were further investigated in the Dry Fork basin. Study findings concluded that a local flood reduction project at Parson would be economically feasible and was recommended for further study. The study also recommended that reconnaissance level investigations be conducted at Camp Dawson and Rowlesburg provided a local cost sharing partner could be identified. No recommendations were made in the report for further study of any reservoir or reservoir system.

In addition, ecosystem restoration project solutions related to acid mine drainage problems were investigated in several Cheat River Tributaries identified by the West Virginia Division of Environmental Protection (WVDEP) and Natural Resources (WVDNR). A reconnaissance level study of the North Branch of Lick Run recommended a Successive Alkalinity Producing System be evaluated further in a feasibility study.

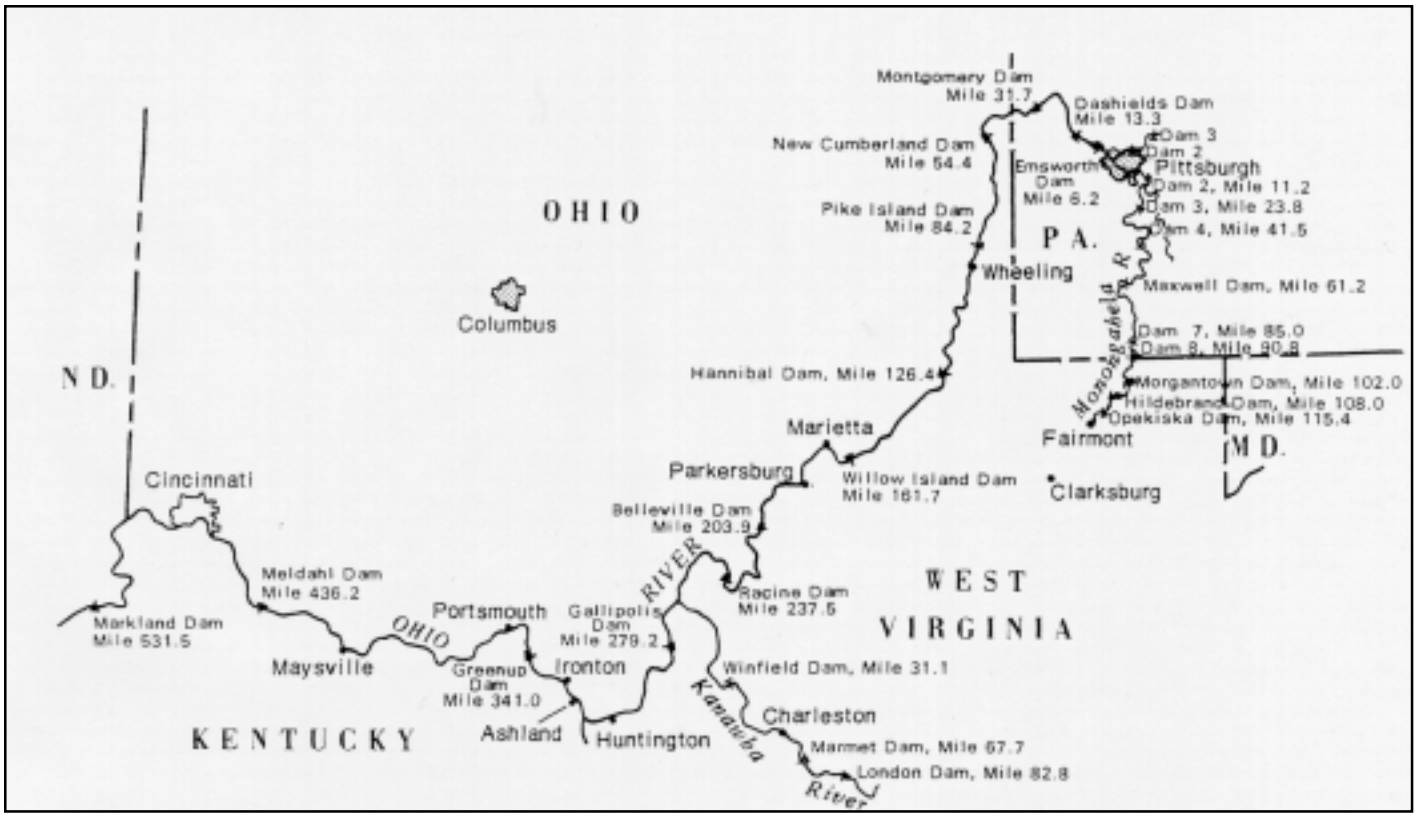
Cheat River Basin Ecosystem Restoration Reconnaissance Study

The study was conducted in accordance with the Energy and Water Development Appropriations Act of 1995 (Public Law 103-316) and funded under the Energy and Water Development Appropriations Act of 1997. The study was a reconnaissance study for ecosystem restoration conducted for the lower Cheat River basin in West Virginia and was completed in October 1997. In coordination with the West Virginia Divisions of Environmental Protection (WVDEP) and Natural Resources (WVDNR), the study focused on remediation efforts in the Sovern Run and Beaver Creek sub-watersheds of the Bid Sandy Creek basin (within the lower Cheat basin). Various types of remediation projects were analyzed and conceptual designs developed with the associated costs. At the request of the WVDEP and WVDNR, the Pittsburgh District is currently preparing a Project Study Plan to move into the feasibility phase for the Livengood Site on Beaver Creek.

Floodplain Information Studies

Floodplain information studies for the West Fork and Monongahela rivers in West Virginia, together with their years of completion, are listed in the following table. All the studies were prepared by the Pittsburgh District.

Locality	Report Published
Harrison County: West Fork River	1976
Harrison County: West Fork River and Elk Creek; Clarksburg and vicinity	1973
Taylor County: Tygart Valley River	1978
Marion County: Monongahela, West Fork, and Tygart Valley rivers	1975
Monongalia County: Monongahela River	1975



Fishing Creek Basin

Description of Area

The headwaters of Fishing Creek are located in the extreme southwest corner of Wetzel County, and its entire drainage basin, 220 square miles, lies within this one county. Two large tributaries, North Fork and South Fork, join at Pine Grove (pop. 675), to form the main stream, which flows northwesterly for 22 miles to the Ohio River at New Martinsville (6,634), the county seat, 128 miles below Pittsburgh. Another important tributary is Little Fishing Creek, which joins the main stream from the east.

The area's topography is rugged, and the basin, except for New Martinsville, is rural and sparsely populated. Job opportunities are limited, and many basin residents commute to work in New Martinsville and nearby areas.

Status of Corps Work

Three snagging- and clearing-projects have been completed in the basin, all carried out under authority of Section 208 of the Flood Control Act of 1954. No planning or floodplain information studies have been undertaken.

Smithfield Snagging and Clearing Project
Huntington District

A project at Smithfield (pop. 197) comprised the snagging and clearing of South Fork Fishing Creek for a distance of 1.13 miles, with minor channel shaping at the Baltimore & Ohio railroad bridge. The upstream limit of the project is the vehicular bridge across South Fork in Smithfield.

Construction was completed in 1962 at a cost of $10,700. The project reduces moderately large floods by about 2 feet at the approximate damage center.

Jacksonburg Snagging and Clearing Project
Huntington District

The project at Jacksonburg (pop. 300) consisted of snagging, clearing, and widening the channel of South Fork Fishing Creek for 0.8 mile, beginning about 0.4 mile below the Jacksonburg highway bridge. The upstream limit is just below the mouth of Richwood Run. Construction was completed in 1959 at a cost of $44,800. The project provides a dependable degree of protection from major floods and reduces the frequency of overbank flows for moderate floods.

Pine Grove Snagging and Clearing Project
Huntington District

The project at Pine Grove (pop. 701), consisted of the snagging and clearing of Fishing Creek for a distance of 9,500 feet downstream from the junction of North Fork and South Fork.

Construction was completed in 1965 at a cost of $34,400. The project serves to reduce the stage of a flood equal to that of 5 March 1963 by about 2 feet in the principal damage area.

Middle Island Creek Basin

Description of Area

The Middle Island Creek basin lies within the counties of Pleasants, Tyler, and Doddridge in northwestern West Virginia. The creek is formed by the confluence of Meathouse Fork and Buckeye Creek near Smithburg (pop. 160), in Doddridge County, and flows in a northwesterly direction to Middlebourne (922), in Tyler County, where it turns southwest, emptying into the Ohio River at St. Marys (2,219), 155 miles below Pittsburgh. Middle Island Creek is about 95 miles long and drains an area of about 560 square miles. The creek and its tributaries meander through winding valleys bounded by steep slopes and high ridges.

The basin has had a history of declining employment in mineral extraction, agriculture, and forestry. During the early years of the century, the area was an important oil- and gas-producing center, but after 1915 this activity decreased. Workers residing in the basin are largely employed in industries along the Ohio River. Population has declined in recent years except for slight gains in areas close to sources of employment along the Ohio.

Status of Corps Work

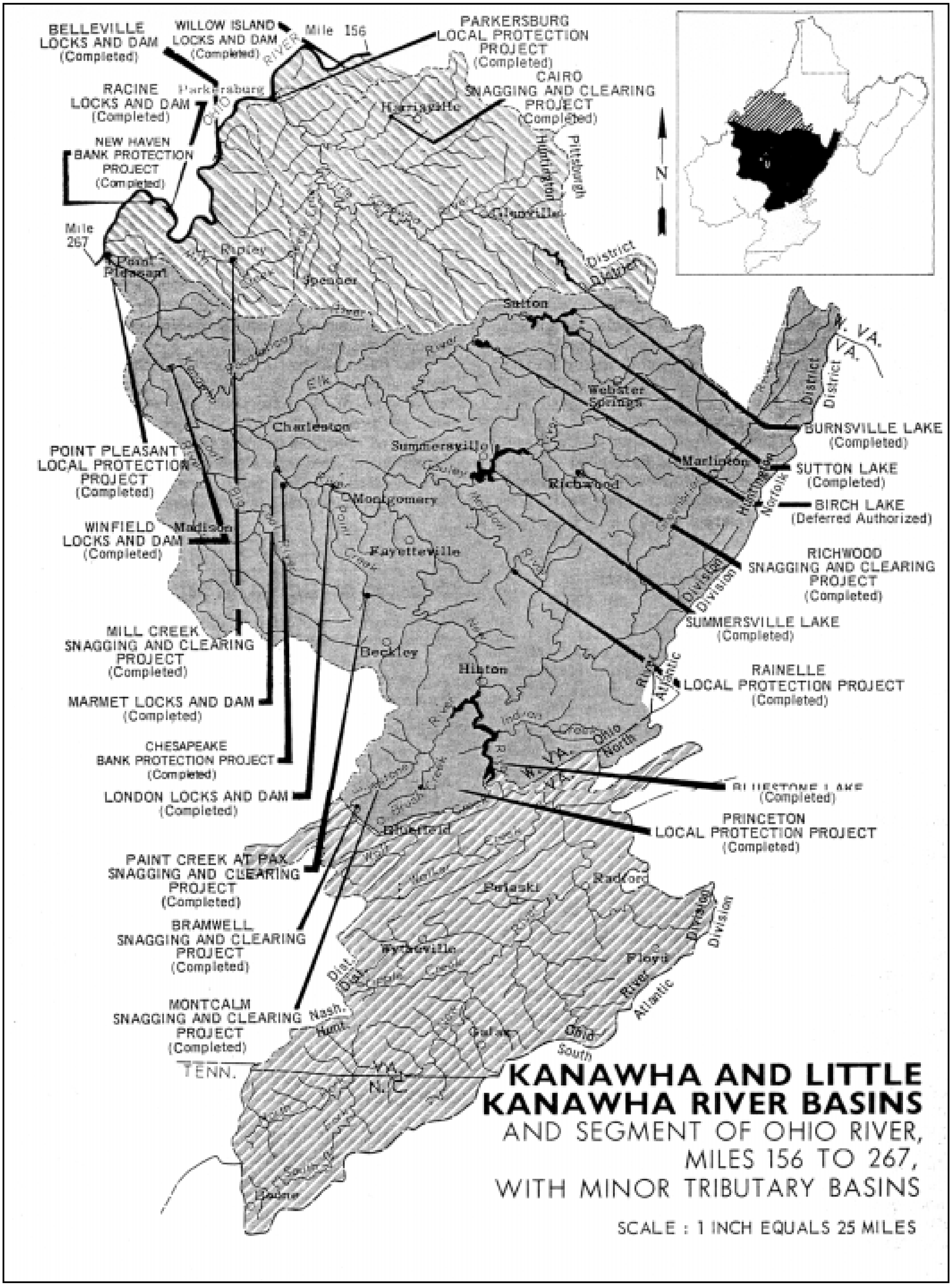
A snagging and clearing project has been completed in the Middle Island Creek basin, and a local planning study has been conducted. A special report providing flood-hazard information concerning Middle Island Creek and tributaries in Doddridge County was completed in 1978.

West Union Snagging and Clearing Project
Huntington District

A snagging and clearing project has been constructed on Middle Island Creek in Doddridge County under authority of Section 2 of the Flood Control Act of 1937. It extends upstream from Piggin Run through West Union (pop. 830). The work, completed in 1952 at a cost of $32,200, included bank clearing, the removal of snags and debris from the streambed, and the widening of one bend. Protection against small floods is provided.

Middle Island Creek Study
Huntington District

As a result of the flood of November 1985, a reconnaissance-level study of the Middle Island Creek basin was authorized by Congress in 1987 to investigate measures for reducing flood damage. The study, completed in April 1989, determined that no potential alternatives for reducing flood damage were economically feasible, and recommended that no further studies be undertaken at that time.



BELLEVILLE LOCKS AND DAM (Completed)
WILLOW ISLAND LOCKS AND DAM (Completed)
Mile 156
PARKERSBURG LOCAL PROTECTION PROJECT (Completed)
CAIRO SNAGGING AND CLEARING PROJECT (Completed)
RACINE LOCKS AND DAM (Completed)
NEW HAVEN BANK PROTECTION PROJECT (Completed)
Mile 267
OHIO RIVER
Parkersburg
Harrisville
Glenville
Ripley
Spencer
Point Pleasant
Sutton
Webster Springs
Charleston
Summersville
Marlinton
Richwood
Montgomery
Madison
Fayetteville
Beckley
Hinton
Bluefield
Pulaski
Radford
Wytheville
Floyd
Galax
Huntington
Pittsburgh
District
Division
Norfolk
W. VA.
VA.
TENN.
N.C.
N
BURNSVILLE LAKE (Completed)
SUTTON LAKE (Completed)
BIRCH LAKE (Deferred Authorized)
RICHWOOD SNAGGING AND CLEARING PROJECT (Completed)
SUMMERSVILLE LAKE (Completed)
RAINELLE LOCAL PROTECTION PROJECT (Completed)
BLUESTONE LAKE (Completed)
PRINCETON LOCAL PROTECTION PROJECT (Completed)
POINT PLEASANT LOCAL PROTECTION PROJECT (Completed)
WINFIELD LOCKS AND DAM (Completed)
MILL CREEK SNAGGING AND CLEARING PROJECT (Completed)
MARMET LOCKS AND DAM (Completed)
CHESAPEAKE BANK PROTECTION PROJECT (Completed)
LONDON LOCKS AND DAM (Completed)
PAINT CREEK AT PAX SNAGGING AND CLEARING PROJECT (Completed)
BRAMWELL SNAGGING AND CLEARING PROJECT (Completed)
MONTCALM SNAGGING AND CLEARING PROJECT (Completed)
KANAWHA AND LITTLE KANAWHA RIVER BASINS
AND SEGMENT OF OHIO RIVER, MILES 156 TO 267, WITH MINOR TRIBUTARY BASINS
SCALE : 1 INCH EQUALS 25 MILES

Little Kanawha River Basin

Description of Area

The Little Kanawha River basin, lying entirely within West Virginia, extends in a northwesterly direction from its headwaters in the central part of the state to Parkersburg (pop. 33,431) on the Ohio River. The watershed has an area of about 2,320 square miles. It's roughly diamond shaped and about 45 miles long at its greatest length, from northwest to southwest.

The Little Kanawha River rises in the extreme southern part of Upshur County, and follows a tortuous course, in a generally northwesterly direction, for a distance of 167 miles to its confluence with the Ohio River at Parkersburg, 185 miles below Pittsburgh. The valley bottom varies in width from slightly more than stream width in the headwaters to more than 1,000 feet near the mouth. The valley walls are steep and the ridges narrow. Hughes River, Leading Creek, Steer Creek, and West Fork are major tributaries, with characteristics similar to those of the main stream.

Pool	Surface Elevation	Surface Area	Capacity
	(Feet above sea level)	*(Acres)*	*(Acre-feet)*
Year-Round Storage:			
Minimum	776	550	4,100
Seasonal Storage: (Summer)			
Recreation/Water Quality Control	789	968	10,100
Flood-Control Storage: ⛭			
Winter	825	1,900	61,700☞
Summer	825	1,900	51,700💣
Total	825	1,900	65,400

⛭ At maximum pool level.
☞ Between elevations 776 and 825.
💣 Between elevations 789 and 825.

In the extreme eastern parts of the basin, ridgetop elevations reach 2,000 feet or more, but the drop westward is rapid and most of the basin is below 1,000 feet.

With the exception of Parkersburg, at the mouth of the stream, there are no large towns. Several of the basin counties have experienced severe declines in population. The principal economic pursuits are gas and oil production, transportation, agriculture, coal mining, and lumbering. The Little Kanawha gas- and oil field was the first to be developed in West Virginia, as early as 1864, but production reached its peak in the early 1900s. Farming is still important, but the basin remains an area of small farms in terms of both size and income.

Status of Corps Work

A snagging and clearing project, a bank-erosion protection project, and a multipurpose reservoir project have been completed in the Little Kanawha River basin. Two additional multipurpose projects are in the inactive authorized category. A flood-damage reduction study and two floodplain information reports have been completed.

Projects

Burnsville Lake
Huntington District

Burnsville Lake is on Little Kanawha River, an Ohio River tributary, 3 miles upstream from Burnsville (pop. 500), Braxton County, and 124 miles above the mouth of the river.

The dam controls the runoff from a drainage area of 165 square miles and is operated for the reduction of flood damage in the Little Kanawha River valley and as a unit in the comprehensive plan for flood control in the valley of the Ohio. It also serves the purposes of both general and fish and wildlife recreation and provides for water-quality improvement during low-flow periods in the backwater reach from the Ohio River's Belleville Pool. The total cost of the project was $57,166,840.

The building of the lake was authorized by the Flood Control Act of 1938. Work on the project was begun in 1972, and the dam was completed in January 1976. Recreational development was completed in January 1984.

The dam is a rockfill embankment with a height of 90 feet above the streambed and a crest length of 1400 feet. A gated spillway with a crest width of 142 feet and a crest elevation of 792 feet is located in the left abutment. A minimum pool is maintained at elevation 776 feet for sediment accumulation, and flood-control storage is provided to maximum elevation 825 feet. The winter floodwater storage capacity is 61,300 acre-feet, equivalent to 6.96 inches of runoff from the upstream drainage area.

In summary, the surface elevations, surface areas, and capacities of Burnsville Lake at designated pool levels are as follows:

The State of West Virginia, Division of Natural Resources (DNR), has a license for fish, wildlife, and forest management at Burnsville Lake. There are 12,452 acres contained in this outgrant. DNR also has a license covering 127.0 acres for the purpose of operating and maintaining sub-impoundments for fish production and rearing. This hatchery is located behind the DNR office, which is part of the licensed area.

Recreational development provides facilities for camping, picnicking, boating, fishing, swimming, and sight-seeing. Included is a historical area at Bulltown. Visitation in 1997 was 375,400. Flood damage prevented is valued at an estimated $77,378,000 through Fiscal Year 1997.

Glenville Emergency Bank-Protection Project
Huntington District

Placement of stone riprap along the left riverbank of the Little Kanawha River at Glenville, river mile 104.0, was completed in September 1986 under authority of Section 14 of the Flood Control Act of 1946. Protection was provided for the sewage lift station. Total project cost was $38,000.

Leading Creek Lake
Huntington District
Deauthorized

Leading Creek Lake was approved by the Secretary of the Army on 22 May 1969 as a substitute for Steer Creek Lake, authorized by the Flood Control Act of 1938. Because of unfavorable economic analysis, however, it was placed in inactive status in November 1974. The project was deauthorized on 1 January 1990.

The dam would be located 0.5 mile above the mouth of Leading Creek, a Little Kanawha River tributary, in Gilmer County, and 101 miles above Parkersburg (pop. 33,431) at the mouth of the Little Kanawha. It would control the drainage from an area of 146 square miles. The project would provide for multipurpose development, including flood control, fish and wildlife conservation, and general recreation.

Spencer Flood Damage-Reduction Project
Huntington District

Under authority of Section 205 of the Flood Control Act of 1948, a channel improvement project along Spring Creek, a tributary of the Little Kanawha River, in Roane County, was completed in December 1994. The project begins at the sewage treatment plant at stream mile 0.51 and extends upstream to the confluence of Goff Run at mile 1.59. The estimated cost of the project is $301,000, $221,000 of which is Federal cost.

West Fork Lake
Huntington District
Deauthorized

The West Fork Lake project, which was authorized by the Flood Control Act of 1938, would be located in Calhoun and Wirt counties on West Fork of Little Kanawha River, 2 miles above the mouth of West Fork and 51 miles above the mouth of the Little Kanawha. It would control the drainage from an area of 237.5 square miles. The project would provide for multipurpose development, including flood control, general recreation, and fish and wildlife conservation.

Because of unfavorable economic analysis, the project was placed in inactive status in November 1974. The project was deauthorized on 1 January 1990.

Cairo Snagging and Clearing Project
Huntington District

A snagging and clearing project on North Fork Hughes River was completed in 1951 under authority of Section 2 of the Flood Control Act of 1937, as amended, at a Federal cost of $29,500. It extends 2.6 miles from near the center of Cairo (pop. 289) in Ritchie County to the mouth of Addis Run. Protection against small floods at Cairo is provided. The streambed and streambanks were cleared of brush, timber, and debris.

Planning Study

Little Kanawha River and Tributaries Study
Huntington District

The purpose of this study was to determine the advisability of modifying the Little Kanawha River portion of the Comprehensive Plan for Flood Control and Other Purposes in the Ohio River basin. The reconnaissance report was completed in July 1990. Funds for the reconnaissance-study phase were appropriated, and study authority was provided through a Senate resolution.

The study identified no flood-control measures indicating economic potential. The report therefore recommended no further study, but did recommend that the Corps assist in non-Federal development of a more reliable flood-warning system.

Floodplain Information Studies

Floodplain-information studies were completed in 1970 for segments of the Little Kanawha River in Glenville (pop. 1,848) and Grantsville (662).

Mill Creek Basin

Mill Creek basin is in the west central part of West Virginia in Jackson, Roan, and Mason counties. The creek drains an area of 237 square miles and empties into the Ohio River at Millwood (pop. 80), about 231 miles below Pittsburgh.

Ripley (pop. 3,023), the seat of Jackson County and the largest community in the basin, is located on the east bank of Mill Creek, 18 miles upstream from the mouth. Sycamore Creek joins Mill Creek at Ripley and has a drainage area of 14 square miles. The establishment of a large industrial plant on the Ohio River near Ravenswood (4,253) has changed the basin's major source of employment from agriculture to manufacturing. Residential and commercial growth has followed the location of the new industry.

A snagging and clearing project has been completed, and a flood plain information study has been carried out.

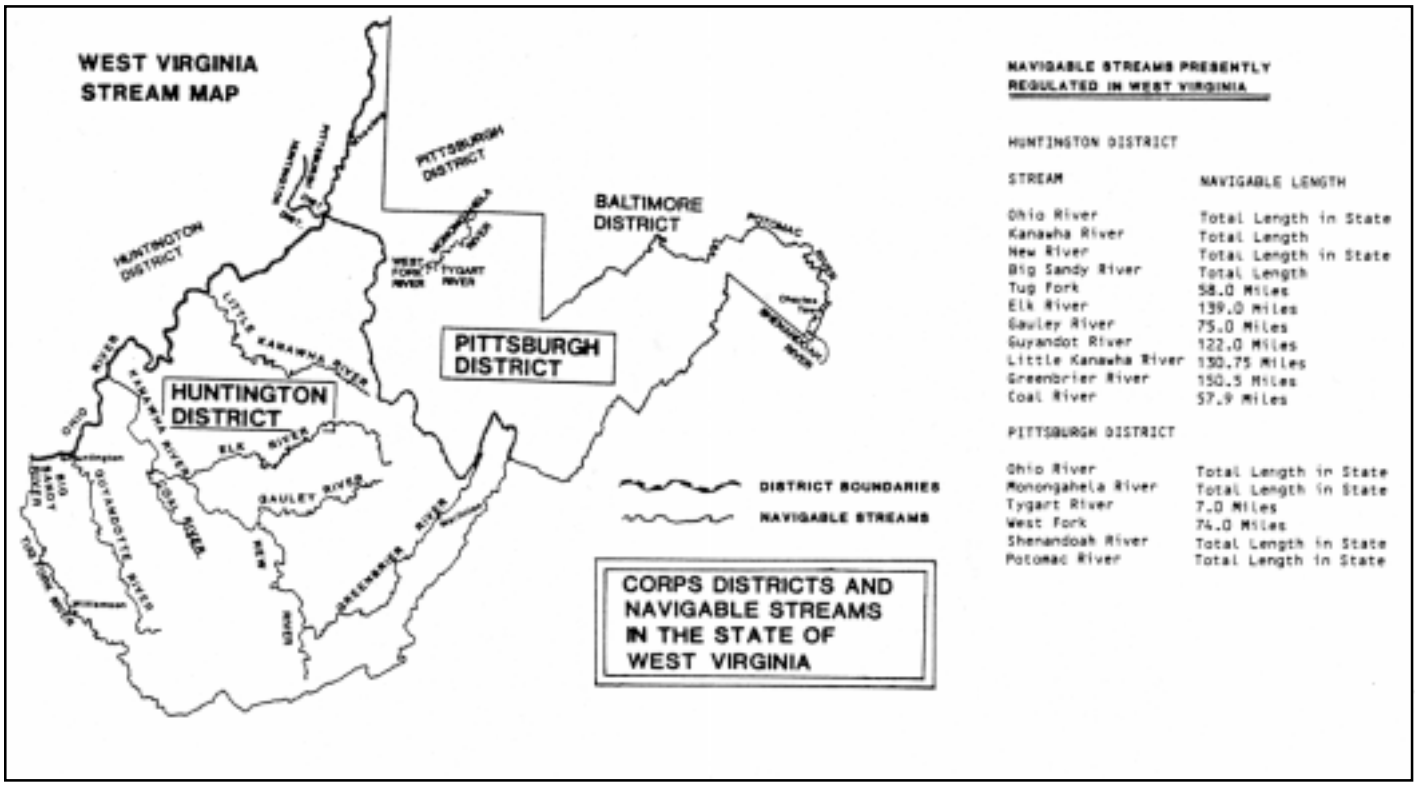
Project

Mill Creek at Ripley
Snagging and Clearing Project
Huntington District

A snagging and clearing project at Ripley, approved by the Chief of Engineers in 1972 under authority of Section 208 of the Flood Control Act of 1954, was completed in August 1977 at a cost of $108,000. The undertaking consisted of about 2.5 miles of channel clearing and snagging and some minor channel shaping, to provide a measure of flood damage reduction. Most of the work was on Mill Creek, but about 500 feet was on Sycamore Creek.

Floodplain Information Studies

A floodplain information study for Mill Creek at Ripley was completed in 1971.



Kanawha River Basin in West Virginia

Description of Area

The Kanawha River watershed, from its headstreams in the mountains of northwestern North Carolina, extends northward across southwest Virginia and northwest across West Virginia to the Ohio River. The basin has a total length of about 190 miles and a total area of about 12,300 square miles, 8,450 square miles of which is in West Virginia, 3,080 in Virginia, and 770 in North Carolina.

The Kanawha River is formed by the junction of the Gauley River and the New River in central West Virginia and flows 97 miles northwestward to the Ohio River at Point Pleasant (pop. 5,002), 266 miles downstream from Pittsburgh. The New River originates in North Carolina and the Gauley River in West Virginia. Principal Kanawha affluents in West Virginia in addition to the Gauley and New rivers are, in descending order, the Bluestone and Greenbrier rivers, tributary to the New River, and the Elk, Coal, and Pocatalico rivers, tributary to the Kanawha River proper. Of the tributaries named, all lie entirely within West Virginia except the Bluestone, which rises in Virginia.

The Kanawha basin economy is varied, its economic activities ranging from subsistence farming to highly sophisticated industrial production. The chemical industry is the major employment category, though coal mining, textile manufacturing, and related services make significant contributions to the economy.

From 1950 to 1970 the region experienced a declining population, reflecting in particular the increased mechanization of coal mining, as well as sagging coal production. The declining trend has since seen a sharp reversal, many counties showing gains of 20 to 40 percent from 1970 to 1980. Greenbrier County's gain in population was 29.6 percent, while Kanawha County--in which Charleston and associated industrial communities are located--gained only 15.6 percent.

Status of Corps Work

There are 14 completed Federal water-development projects in the Kanawha River basin in West Virginia. Three of these are lock and dam structures on the main stem of the Kanawha River, four are large multipurpose lakes, and the remaining seven are local flood-protection projects. An authorized lake project has been classified as deauthorized.

A Kanawha Basin Comprehensive Study was submitted in 1971 that provides a framework for further and continuing studies of water-resource management within the basin. Subsequent emphasis was placed on possibilities of hydroelectric development in conjunction with a reformulation review of existing reservoirs. Possibilities for the reduction of flood damage are being studied for two localities.

An investigation of modernization of the Kanawha River navigation system is being carried out under authority of a Senate resolution.

Two local flood-reduction studies are in progress under a special continuing authority, and three channel-modification projects have been constructed. Four snagging and clearing projects have been completed under another such authority.

Kanawha River Navigation System
Huntington District

The existing Kanawha River navigation system was constructed between 1931 and 1937, consisting of four units—the London, Marmet, and Winfield locks and dams on the Kanawha River and the Robert C. Byrd Locks and Dam on the Ohio River below the mouth of the Kanawha. The first two of these structures were built under authority of the River and Harbor Act of 1930, the other two under authority of the Act of 1935.

The indicated structures, in conjunction with channel dredging, provide a slackwater channel with a minimum depth of 9 feet to a point 91 miles above the mouth of the Kanawha. The Robert C. Byrd Locks and Dam serves also as a unit of the canalization system for the Ohio River and is described in this booklet as a part of that system. Twin lock chambers are provided at each of the navigation dams.

Hydroelectric power plants have been built at each of the navigation dams on the Kanawha River by the Kanawha Valley Power Company, under Federal Power Commission licenses, and are operated by that company. Substantial annual payments are made to the United States for water rights. The total installed capacity is 43,560 kilowatts.

The Kanawha River improvement provides West Virginia with access to the shipment and receipt of commodities by water over the entire Mississippi River waterways system and over the Gulf Intracoastal Waterway. Traffic amounting to 48 million tons moved in 1997. During the past 7 years, traffic has grown from 21 million tons annually to 48 million tons.

The total first cost of the system was $23,600,000. This total is for the present facilities, including Robert C. Byrd Locks and Dam on the Ohio River, but does not include a cost of about $3,910,000 for older facilities that were replaced. Winfield Locks and Dam is the busiest lock and dam in the

United States and has recently had an additional new modernized lock completed next to the existing chamber. The modernized lock chamber became operational in 1997. Additional improvements of the system are contemplated with the construction of a new lock at Marmet Locks and Dam, which are scheduled to begin 2000.

London Locks and Dam
Huntington District

London Locks and Dam, the farthest upstream of the navigation structures on the Kanawha River, is located in Kanawha County a short distance downstream from Montgomery (pop. 2,291). The dam provides a channel with a minimum navigable depth of 9 feet, extending upstream about 8 miles to the head of navigation at Deepwater (500), and serving principally the coal mines near the head of the Kanawha River. The project was completed in 1934, replacing several low-lift dams constructed in the nineteenth century. Total Federal cost was about $3,300,000.

London Locks are twin, parallel chambers, each 56 feet wide and 360 feet long, providing a lift of 24 feet between the normal pools. Studies are underway to determine the feasibility of alternative lock improvements at London and are scheduled for completion in 1997. The nonnavigable roller gate dam has a top length of 557 feet, extending between the locks at the right bank and the hydroelectric plant at the left abutment. The powerhouse contains three turbine generator units, each with a capacity of 4,800 kilowatts.

There are no recreation facilities at the project, but fishing and sight-seeing drew 11,900 visitors in 1997.

Marmet Locks and Dam
Huntington District

Marmet Locks and Dam is located a short distance above Charleston. It provides a pool with a minimum navigable depth of 9 feet, extending 15 miles to London Dam. The project was completed in 1934 as part of the plan to replace the older low-lift dams and locks on the upper Kanawha River. The locks, located on the right bank, are twin parallel structures, each 56 feet wide by 360 feet long, and provide a lift of 24 feet between the normal pools. The dam is a nonnavigable roller-gate structure with a top length of 557 feet. Like the other Kanawha River dams, Marmet Dam has a privately owned hydroelectric plant at the left abutment. There are three turbine generators, each with a capacity of 4,800 kilowatts. The cost of the dam and locks, which is all Federal, was about $3,600,000.

Recreation facilities consist of two picnic shelters at the site of the locks, and a fishing access area provided by Kanawha Power Company at the tailwaters of the hydropower plant. Visitation in 1997 totaled more than 77,800.

A modernization plan has been approved by the Chief of Engineers that includes the construction of an additional landward lock chamber, 110 feet by 800 feet. Construction has not been authorized by Congress.

Winfield Locks and Dam
Huntington District

Winfield Locks and Dam is the downstream unit of the three Kanawha River navigation projects. Winfield Dam is 31 miles above the mouth of the Kanawha River and 28 miles down-stream from Charleston (pop. 56,915). It provides a channel with a minimum navigable depth of 9 feet, extending 37 miles to Marmet Dam. The project was completed in 1933 and was constructed, along with Robert C. Byrd Locks and Dam on the Ohio River, to replace the prior system of low-lift dams provided in the lower Kanawha River in the late 1800s.

The Winfield locks are on the right bank and consist of twin parallel chambers, each with clear interior dimensions of 56 feet in width by 360 feet in length. A lift of 28 feet is provided between the normal pools. The dam is a nonnavigable roller-gate structure with a top length of 677 feet. Like the other Kanawha River dams, Winfield Dam has a privately owned hydroelectric plant at the left abutment with a capacity of 14,400 kilowatts. The cost of the dam and locks was about $6,300,000.

Downbound traffic through Winfield Locks consists almost entirely of coal, the larger part being steam coal destined for electricity-generating plants on the Ohio River, and a smaller but substantial part being metallurgical coal destined for steel mills in the Pittsburgh, Wheeling, and Cincinnati areas. Upbound traffic through Winfield consists mainly of chemicals for the large industrial complex at Charleston.

No recreation facilities are provided at the locks site, but there is a fishing access area at the tailwater of the power station, and a boat-launch area is located in Charleston's Daniel Boone Park. Visitation in 1997 was 481,100.

The modernization of the Winfield Lock includes an additional 110 feet by 800 feet lock chamber on the right descending bank, landward of the existing lock chambers. The completed project also includes a new 110-foot-wide gate bay with a hydraulically operated tainter gate. Phase I construction, excavation and cofferdam, was completed in October 1991. Construction of the new lock and gate bay was delayed until the summer of 1994 because hazardous substances were discovered on the former ACF Industries property in the upstream approach to the new lock. The locks were opened and operational in 1997.

New River Basin Projects

Bluestone Lake
West Virginia and Virginia
Huntington District

Bluestone Lake is situated on New River, a Kanawha River formation stream, in Summers, Mercer, and Monroe counties, West Virginia, and Giles County, VA. The reservoir, built under authority of an executive order of 1935 and the Flood Control Acts of 1936 and 1938, is upstream from Hinton (pop. 3,338), and above the junction of the Greenbrier River. The dam is 65 miles above the junction of New River with Gauley River to form the Kanawha, and 162 miles above the Kanawha's confluence with the Ohio. The project controls the runoff from a drainage area of 4,565 square miles, having its headwaters in northwestern North Carolina.

The impoundment is operated to reduce flood damage along the New and Kanawha rivers and as a unit of a coordinated system for flood protection along the Ohio and lower Mississippi rivers. Building of the dam was begun in 1942, suspended during World War II, and completed for operation in 1949. The total cost of construction through 1974 was $29,218,000. Bluestone Lake lands and waters, except at the dam site, are managed by the West Virginia Division of Natural Resources and the Department of Commerce for recreation purposes and for forest, fish, and wildlife conservation. The Bluestone State Park area adjoining the lake has been developed.

The dam is a concrete gravity structure with a height above streambed of 165 feet, a length of 2,048 feet, a gated overflow spillway, and outlet works through the structure. Penstocks were incorporated to permit the future installation of power facilities.

A seasonal pool is maintained during the summer recreational season at elevation 1410, with an area of 2,040 acres. During the winter and spring months the pool is lowered to minimum elevation 1406. From the minimum pool level to elevation 1520, a storage capacity of 600,100 acre-feet is available for the temporary storage of floodwaters. The pool's length along the main stream ranges from 9.5 miles at minimum level to 36 miles at maximum. The length of the recreational pool is 10.7 miles.

Estimated cost savings in terms of the damage prevented by the Bluestone project since it became operational more than $1.5 billion through 1997.

Facilities are provided at Bluestone Lake for camping, picnicking, boating, fishing, sight-seeing, swimming, and hiking. Public attendance during 1997 totaled some 1,186,800.

Facilities provided by the Corps of Engineers at two below-dam recreation areas include picnic shelters, fisherman access, playgrounds, and a visitor center.

The Corps currently has three project studies underway that include hydropower development, Dam Safety Assurance and drift-and-debris management. Section 102 of the Water Resources Development Act of 1992 (Public Law 102-106 Stat. 4797) directed the Corps to address the problem of accumulated drift and debris at the project.

Montcalm Snagging and Clearing Project
Huntington District

The Montcalm project, carried out under authority of Section 208 of the Flood Control Act of 1954, is on the Bluestone River at Montcalm (pop. 1,023), in Mercer County. It consisted of snagging and clearing about 3 miles of channel. The project will reduce the highest known flood by about 2 feet and greatly reduce the frequency of overbank flooding. Construction was completed in 1965 at a Federal cost of $32,000.

Princeton Local Flood-Protection Project
Huntington District

The Princeton local flood-protection project is located on Brush Creek in Mercer County. Principal features are 3.9 miles of channel improvement, the construction of one railroad bridge and extension of another, the construction of two highway bridges, and 0.3 mile of railroad relocation. The project provides virtually complete protection to Princeton (pop. 6,951) from floods having 20 percent greater discharge than the June 1924 maximum of record.

The project, built under authority of the Flood Control Act of 1958, was completed and transferred to local interests for maintenance in 1961. The project cost was $1,195,000, about $386,000 of which was the local share. Estimated cost savings resulting from the damage prevented by the project through 1997 is $3,565,000.

Bluestone Lake, West Virginia
Huntington District
Underway

This project is located in the New River Basin in Hinton, West Virginia. The recommended plan involves raising the existing dam 13 feet, anchoring the dam to ensure its sability against the new construction, and downstream thrust blocks. Estimated project costs are nearly $88.4 million. Project construction is scheduled to begin in 2000.

Gauley River Basin Projects

Richwood Snagging and Clearing Project
Huntington District

The Richwood snagging and clearing project, carried out under authority of Section 208 of the Flood Control Act of 1954, is in Nicholas County. It consisted of straightening,

deepening, and widening the channel of Cherry River, a Gauley River affluent, through Richwood (pop. 2,792), and removing two bars from the channel at Fenwick (400). Construction was carried out in 1955 at a total cost of $59,400, all Federal. An additional section of the channel was improved in 1958 at a cost of $14,200. The improved channel provides substantial protection against small floods, which occur almost annually, and provides limited protection against larger floods.

Summersville Lake
Huntington District

Summersville Lake, built under authority of the Flood Control Act of 1938, is located on Gauley River near Summersville (pop. 3,096), in Nicholas County. The dam is 35 miles above the junction of the Gauley with New River to form the Kanawha, and 132 miles above the confluence of the Kanawha with the Ohio. The project controls the runoff from a drainage area of 803 square miles.

The lake serves to reduce flood damage in the downstream reach of Gauley River and is operated as a unit of a coordinated reservoir system for flood protection in the Kanawha, Ohio, and lower Mississippi river valleys. Additional benefits are obtained through improvements in water quality in the industrialized areas above and below Charleston (pop. 56,915), along the Kanawha River, together with lesser benefits obtained along the Ohio. The lake and adjoining lands are employed for the conservation of fish and wildlife and serve varied recreational uses, including fishing, boating, water-skiing, picnicking, camping, hiking, and sight-seeing.

The project was built between 1960 and 1966 at a cost of $48,075,800, all Federal. Estimated cost savings associated with flood damage prevented through 1997 totaled $397,319,000. Facilities are available for boating, fishing, camping, swimming, and picnicking. Public attendance at Summersville Lake during 1997 was 913,200. Below Summersville Dam, the Gauley River has become popular with whitewater enthusiasts. In 1996, 47,600 whitewater boaters began their trip there.

The dam is of rockfill construction, with an impervious core. Its maximum height is 390 feet, and the top length is 2,280 feet. Controlled discharges from the reservoir are normally made through a 29-foot-diameter tunnel, dividing at its downstream end into three 11-foot-diameter conduits. Flow is controlled by three 9-foot-diameter Howell-Bunger fixed-cone dispersion valves. For the release of flows in excess of the reservoir capacity, an uncontrolled spillway is provided 3500 feet west of the right abutment. The spillway's crest is 1250 feet long, with an elevation of 1,710 feet above sea level. Dikes are required at two low points in the west rim of the reservoir. The design discharge is 412,000 cubic feet per second, with a surcharge of 23 feet and a freeboard of 5 feet.

During the flood season, a minimum pool with a surface of 928 acres and a capacity of 57,900 acre-feet is normally maintained at elevation 1,575 feet. In late spring, after the danger of major flooding has passed, the pool is raised to elevation 1,652, with a surface area of 2,790 acres, thereby making available 133,600 acre-feet for low-flow augmentation in the Kanawha River during the normally dry summer season. The reservoir capacity available for the temporary storage of flood waters varies from a minimum of 221, 900 acre-feet in summer to a maximum of 355,500 acre-feet in winter. At full flood-control pool, elevation 1,710 feet, the lake would have an area of about 4,920 acres. The length of the lake along the main stream ranges from 8.7 miles at the minimum pool level in winter to 18.6 miles at maximum floodwater storage. During the summer, the pool is 13.7 miles long.

The operational modifications at the Summersville Lake project to enhance whitewater recreation were well received by the whitewater community, business leaders, and State officials. During the 1997 whitewater season, the estimated 47,600 boaters entering the Gauley River at Summersville Dam accounted for over $45 million in direct and indirect economic benefits to the area.

Rainelle Local Flood-Protection Project
Huntington District

The Rainelle local flood-protection project, authorized by the Flood Control Act of 1958, is at Rainelle (pop. 1,672), in Greenbrier County. It consists of 4.3 miles of channel improvement on Meadow River and its tributaries, Sewell and Boggs creeks, a new highway bridge, modification of a railroad bridge, and modification of sewage and drainage facilities. The channel work is located in part of Fayette County. The project provides nearly complete protection from floods equivalent to the March 1934 flood of record.

The project was completed and transferred to local interests for maintenance in January 1962. Total costs were about $685,000, of which the local share was about $60,000. Estimated cost savings for flood damage prevented since the project was completed are $2,587,000 through fiscal year 1997.

Lilly Park Flood-Damage-Reduction Study
Huntington District

A feasibility report is being prepared under authority of Section 205 of the Flood Control Act of 1954, addressing flood problems along Sewell Creek at Lilly Park, West Virginia. Sewell Creek is a tributary of the Meadow River in the vicinity of Rainelle in Greenbrier County, West Virginia.

Elk River Basin Projects

Sutton Lake
Huntington District

Sutton Lake, built under authority of the Flood Control Act of 1938, is on Elk River in Braxton and Webster counties. The dam, a mile above Sutton (pop. 926), seat of Braxton County, and 101 miles above the mouth of Elk River at Charleston (56,915), controls the runoff from a drainage area of 537 square miles. Construction of the dam was begun in 1949 and completed in 1961. The cost of the project was $34,900,000, and the cost savings associated with flood damage prevented through 1997 are estimated at $257,963,000.

The Sutton Lake project relieves flood hazards along the Elk River, and in conjunction with Bluestone and Summersville lakes provides flood protection for the Kanawha valley and reduces flood flows along the Ohio River. To the extent consistent with water-quality control, the Corps of Engineers operates five recreation and access sites at the lake. The Corps provides facilities for camping, picnicking, boating, fishing, swimming, and sight-seeing. Public attendance at Sutton Lake in 1997 exceeded 502,500. Through a lease agreement, the West Virginia Department of Natural Resources manages the fish and wildlife. In addition, 11,725 acres are part of the Elk River Public Hunting and Fishing Area. The Sutton recreation master plan was updated in August 1984.

Sutton Dam is a concrete structure 1,178 feet long with a maximum height of 210 feet. A gated overflow spillway is located in the channel section of the dam, which also contains five gated sluices for passing normal flows.

A minimum pool with a surface area of 870 acres at elevation 895 feet is maintained during the winter flood season. Starting in April, the pool is raised until by the first of June a seasonal pool elevation of 922 is reached, with a surface area of 1,440 acres. The seasonal pool provides 59,700 acre-feet of storage for water-quality control along the Elk and Kanawha rivers. The lake capacity available for the storage of flood waters, at a maximum pool elevation of 1,000, varies from 205,600 acre-feet during the summer to 236,100 acre-feet during the winter.

The outlet works at Sutton Dam were modified in 1980 to improve the environmental attributes of Elk River. A high-level intake system was installed, permitting the withdrawal of water for downstream release from the upper zone of the reservoir.

Other Kanawha Basin Projects

Coal River Basin Channel-Rehabilitation Project
Huntington District
Inactive Authorized

Section 214 of the Flood Control Act of 1970 authorizes the Corps to rehabilitate streams in the Coal River basin in the interest of flood control. A report has been prepared that assesses the extent of the problem, identifies and evaluates potential solutions, and recommends economically feasible projects for four areas in the basin. The areas include Sylvester-Whitesville, Madison-Danville, Van-Clinton, and Greenview-Sharples. Snagging and clearing the streambanks would be accomplished in all areas and additional channel shaping and restoration would be accomplished in the Madison-Danville and Van-Clinton areas. The report on the potential projects was approved in May 1975, but laxness in the acquisition of rights-of-way by local interests suggests that they may never be constructed.

Paint Creek at Pax Snagging and Clearing Project
Huntington District

A stream improvement project at Pax (pop. 161), Fayette County, authorized under Section 208 of the Flood Control Act of 1954, involved Paint Creek, a Kanawha River tributary. The project, providing for the snagging and clearing of about 16,000 feet of stream channel to alleviate the flood problem in Pax and nearby communities, was completed in July 1977 at a cost of about $72,000.

Chesapeake Emergency Bank-Protection Project
Huntington District

Slush-grouted stone riprap was used along the Kanawha River at Chesapeake (pop. 1,888) at about river mile 70.0 to protect a storm sewer outlet and town street. The work was completed in October 1981 under authority of Section 14 of the Flood Control Act of 1946 and was accepted by the town in March 1982. The cost of the project was about $9,300.

Dunbar Emergency Bank-Protection Project
Huntington District

The placement of stone riprap along the Kanawha River at Dunbar (pop. 8,621), river mile 52.5, was completed in December 1986 under authority of Section 14 of the Flood Control Act of 1946. Protection is provided for sewage facilities along the riverbank. The completed work was accepted by the City as non-Federal sponsor in February 1987. The cost of the project was about $153,000.

Cabin Creek Local Protection Project
Huntington District

The Cabin Creek project was authorized by Section 601 of PL 99-662. A reevaluation study completed in March 1991 determined that a Federal interest no longer existed for the Cabin Creek project. The project was subsequently deactivated.

Kanawha River, St. Albans City Park
Special Legislation Project
Huntington District

Funds to initiate this study were received by the District on 4 September 1991. Construction of a streambank erosion

project to protect a 1400-reach of the City Park situated between U.S. Route 60 and the Kanawha River was initiated under authority of the Energy and Water Development Appropriations Act of 1991 (P.L. 101-514). The City of St. Albans is acting as the non-Federal sponsor. The Project Cooperation Agreement was signed between the sponsor and the Corps of Engineers 4 May 1996. Construction is scheduled to begin June 1996.

Kanawha River, Kanawha City
Special Legislation Project
Huntington District

Funds to initiate this study were received by the District on 1 November 1991. Correspondence has been forwarded to the City of Charleston to ascertain their interest in acting as the non-Federal local sponsor for this project. The City of Charleston subsequently agreed to serve as the non-Federal sponsor for the project, which was completed in late 1992.

St. Albans Emergency Bank Protection Project
Huntington District

The construction of a project for the protection of U.S. Route 60 along the left descending bank of the Kanawha River at St. Albans was initiated under authority of Section 14 of the Flood Control Act of 1946, as amended. The project was completed April 1995 at a cost of $2,164,000. The non-Federal sponsor's share, the West Virginia Department of Transportation, amounted to $1,728,000.

Buffalo Emergency Bank Protection Project
Huntington District

The project, located along the right descending bank of the Kanawha River at Cross Creek, was designed for the protection of State Route 62. The 280-foot stone slope protection project, was completed 12 October 1993 under authority of Section 14 of the Flood Control Act of 1946, as amended, at a total cost of $160,000. The sponsor was the West Virginia Department of Transportation, Division of Highways.

Planning Studies

The following are the planning studies concerning the Kanawha River basin and the status of each.

Kanawha Basin Comprehensive Study
Huntington District

The Kanawha Basin Comprehensive Study was conducted by the Huntington District of the Corps of Engineers along with several agencies within the departments of Agriculture, the Interior, and Health, Education and Welfare, the Federal Power Commission, and State representatives from West Virginia, Virginia and North Carolina. The Huntington District, in addition to being a major study participant, was assigned the role of study leader. The study resulted in a comprehensive plan formulated to provide optimum use of the water and related land resources of the Kanawha basin.

The plan was developed to reflect a balanced consideration of features for fish and wildlife enhancement, navigation, hydroelectric power, water supply, land treatment and stabilization, environmental quality, regional development, flood prevention and control, recreation, and water-quality control.

The report on the study was submitted to the Water Resources Council in 1971. The plan provides a framework for continuous management and development by Federal, State, and local agencies of the water and related resources of the Kanawha basin.

Subsequent survey studies reflect changes in concepts for optimum use of the basin's water resources that have occurred since the comprehensive basin studies were accomplished during the late 1960s. A major item has been an evaluation of the potential for hydroelectric power.

The development of a feasibility report considering the addition of hydroelectric generating facilities at Summersville Dam was completed in 1982. A recommended hydro plan was included in a reformulation of the project, but the proposal was inadequately supported and was withdrawn from the review process.

The advisability of modifications at the existing Bluestone Lake project was considered, having in view the changes that have taken place in the area during the 35 years since the project was completed. Reformulation of the project was considered, and an 11-foot increase in the summer pool was found to be desirable for recreation, both downstream and at the reservoir. It was concluded, however, that an increase in the volume of stored water would be unwise at this time because of the likelihood that such conditions would cause water-quality problems. The study was concluded in 1988 with the finding that only minor operational adjustments should be undertaken at this time.

A feasibility study for the prevention of flood damage on the Greenbrier River is currently being conducted. A wide range of measures is being considered, including a main-stem dam, tributary dams, upstream watershed dams, and local protection projects at Marlinton, Ronceverte, and Alderson, as well as nonstructural elements. By the end of 1989, the feasibility study was 75 percent completed. Lack of funding has prevented the completion of additional work to date.

Kanawha River Navigation Study
Huntington District

A Kanawha River navigation study was authorized by a Senate resolution adopted on 1 October 1979. The purpose of the

study was to determine whether additional navigation improvements, including replacement or modernization of any of the three navigation projects on the Kanawha, are required to meet regional- or national-waterway transportation needs.

Interim feasibility studies for Winfield Locks and Dam were completed in September 1986. The plan called for an additional lock, 800 feet by 110 feet, adjacent to the existing locks, with continued use of the existing chambers, each 360 feet by 56 feet.

The recommended plan was authorized by the Water Resources Development Act of 1986. The report of the Chief of Engineers was approved in October 1988. Phase 1 plans and specifications were completed in December 1989, and Phase 1 construction for the new lock began in May 1990.

An interim feasibility report for Marmet Locks and Dam was begun in October 1987. Several alternative plans for replacement locks or a new lock-and-dam project are being investigated. The studies and report on Marmet are scheduled for completion in 1995.

An interim report for improvements at London Locks and Dam is scheduled for completion in 1994.

Hugheston Flood-Damage-Reduction Study
Huntington District

A Reconnaissance Report was prepared under authority of Section 208 of the Flood Control Act of 1948, addressing the flood problems along Hughes Creek, a right-bank tributary of the Kanawha River, in the Hugheston vicinity of Kanawha County. The Report was completed in October 1983. A Draft Feasibility Report was completed in March 1990. The Final Feasibility Report was completed in April 1991. A local sponsor to share in the cost of the project has not been found.

Charleston Riverfront Park
Huntington District

The Charleston Riverfront Park is authorized by PL 101-514 and PL 89-72. The riverfront park named Hadad Park features a riverfront pier or esplanade and staging area, an amphitheater, walkways, a restroom, and landscaping. The facilities are designed to accommodate music and cultural events for 2,000 to 5,000 people in the amphitheater; the Sternwheel Regatta, with concerts, races, and concessions; and day-use activities, including sight-seeing, picnicking, noon lunches for downtown workers, sunbathing, viewing the riverscape, observing community-sponsored entertainment, biking, walking, and fishing.

The Project Cooperation Agreement was executed by the City of Charleston and the Huntington District in December 1992. Construction was initiated in July 1993 and was completed in 1995. The total estimated cost of the project is $6.0 million. The visitation for 1997 was estimated at 25,000.

Floodplain Information Studies

Floodplain-information studies for the Kanawha River basin in West Virginia have been made by the Huntington District relating to Madison, on Little Coal River (1970); Town of Birch River in Nicholas County, on Birch River (1974); and Marlinton, on Greenbrier River (1974).

Guyandotte River Basin

Description of Area

The Guyandotte River basin is located entirely within West Virginia, in Raleigh, Wyoming, Mingo, Logan, Boone, Lincoln, Kanawha, Putnam, and Cabell counties. The Guyandotte River is formed by the junction of Winding Gulf and Stonecoal Creeks in Raleigh County and flows in a northwesterly direction to its confluence with the Ohio River at Huntington (pop. 54,623), 305 miles below Pittsburgh. The watershed for the most part is extremely rugged, but in the lower basin the slopes are more moderate and the ridges are not as high. The Guyandotte has a total length of 167 miles and drainage area of 1,671 square miles. Of the five tributary streams with drainage areas of more than 50 square miles, the largest is Mud River, whose basin occupies 350 square miles.

Except for a small part of Huntington, the Guyandotte basin contains no large communities. The population is substantial, but through the middle and upper portions of the basin the distribution is confined almost altogether to stream bottoms, or in some cases ravines, in or near active coal-mining areas. The steepness of the ridge slopes inhibits transportation and community development. The total population of the basin has been decreasing. The principal economic pursuit is coal mining, and transportation is primarily concerned with the handling of coal. The basin contains a large portion of one of the nation's great bituminous coal fields. Most of the coals are of high-quality metallurgical, domestic, steam, and byproduct types.

Status of Corps Work

R. D. Bailey Lake was completed in the Guyandotte basin in 1980. Other completed undertakings include a small flood-control project and a bank-protection project. A channel-modification project for local flood protection has been authorized and is undergoing post-authorization planning. Two planning studies are in progress, and two floodplain-information reports have been completed.

Projects

Oceana Local Flood-Protection Project
Huntington District
Deferred Authorized

Construction of a channel-modification project on Clear Fork, a tributary of Guyandotte River, in Wyoming County, was authorized by Congress in September 1976. Flood protection and recreation facilities would be provided for Oceana (pop. 1,772) and vicinity.

Oceana is located about 30 miles upstream from R. D. Bailey Dam. The authorized project consists of enlarging the Clear Fork Channel for about 25,000 feet, from the confluence of Laurel Fork with Clear Fork downstream through Oceana, Lillyhaven, and Lillydale. The channel width would be increased, with excavation limited to one side of the stream where possible. Recreation facilities would be designed to meet the day-use needs of the community.

The Oceana project is the outgrowth of an upper Guyandotte River basin study requested by Congressional resolutions in 1963 and 1964. This study was completed in 1974, with the Oceana project as a resulting recommendation.

Funds were appropriated and post-authorization planning was started during 1978. Alternative plans were evaluated and presented to the public in 1980. Studies were terminated, however, because of lack of non-Federal participation.

Island Creek Local Protection Project
Huntington District
Authorized

The Island Creek basin study was undertaken as a part of the Guyandotte River basin study authorized by Congress in a resolution of the Committee on Public Works of the U.S. Senate, adopted 2 June 1976. The Island Creek basin study was completed in 1985. The recommended plan consists of a combination of channel improvements and nonstructural measures authorized in Section 401 of the Water Resources Development Act of 1986, PL 99-662. The project includes channel widening to 110 feet for the first 0.7 mile on Island Creek. More than 1200 residential structures would be raised and nearly 80 commercial structures would be floodproofed on Island Creek, Coperas Mine Fork, and Mud Fork. A reevaluation study is now under way in which the authorized plan is being reexamined.

R. D. Bailey Lake
Huntington District

R. D. Bailey Lake is located on the Guyandotte River in Mingo and Wyoming counties a mile northeast of Justice (pop. 400), in Mingo County. Most of the lake is in Wyoming County. The dam is 112 miles above the Guyandotte and Ohio rivers at Huntington (54,623). Work on the project, authorized under the Flood Control Act of 1962, was begun in 1967. The dam was completed in 1980 and dedicated in August 1980.

The project serves primarily for the reduction of flood damage in the Guyandotte River valley and as a unit in a comprehensive system for flood control in the Ohio and lower Mississippi valleys. Other purposes include the

improvement of water quality in the Guyandotte by increasing low flows, recreation, and fish and wildlife conservation. The seasonal (summer) pool along the main stream is 7.1 miles long.

A minimum pool at elevation 1,012 feet serves for sediment deposition and winter recreation. A recreation/water-quality control pool (seasonal pool) at elevation 1035 is reserved for low-flow augmentation. Flood-control storage is provided to maximum elevation 1155. The winter floodwater storage capacity is 181,700 acre-feet, equal to 6.3 inches of runoff from the upstream drainage area of 540 square miles.

The dam is a concrete-faced rock-and-random-fill structure, 1,370 feet long and 310 feet high. The outlet works for normal flow consist of a horseshoe tunnel controlled by sluice gates for selective withdrawal. The spillway is of the broad-crested uncontrolled type, 300 feet wide, located in a cut on the valley wall near the right abutment. Relocations included 25 miles of single-track Norfolk and Western Railway coal line and 13 miles of highways.

The completed cost of the project was $215,972,000, all Federal. The project has already prevented an estimated $120,682,000 in flood damage through fiscal year 1997.

Facilities are provided at R. D. Bailey Lake for camping, picnicking, boating, fishing, sight-seeing, and hiking. Visitation in 1997 was 166,318.

Barboursville Bank-Protection Project
Huntington District

The Barboursville bank-protection project was authorized by H.B. 2671, PL 88-121. The project involved the repair and restoration of the bank of the Guyandotte River in the vicinity of Water Street in Barboursville (pop. 2,801), Cabell County.

The work consisted of placing dumped rockfill on the right bank of the river to prevent erosion, and performing channel excavation on the opposite bank. Construction was completed in 1965 at a Federal cost of $148,000. Local interests are required to maintain the project.

Barboursville Emergency Bank-Protection Project
Huntington District

A project was designed and constructed for the protection of the sewage lagoon for the Village of Barboursville under authority of Section 14 of the Flood Control Act of 1946, as amended. Construction was completed April 1995 at a total cost of $642,000 (non-Federal share-$178,000). The Village of Barboursville was the local sponsor for this project.

Griffithsville-Yawkey Small Flood-Control Project
Huntington District

The Griffithsville-Yawkey undertaking is a small flood-control project on Middle Fork of Mud River in Lincoln County, consisting of 18,900 feet of channel improvement, carried out under authority of Section 205 of the Flood Control Act of 1948, as amended.

A major portion of the channel was widened and straightened and the full length cleared. The work was completed in 1968 at a Federal cost of $517,400. Estimated cost savings resulting from damage prevented through 1994 are $484,000.

Total projectection savings for the Mud River through 1997 is $550,000.

Section 14 Project Mud River Sewage Lagoon
Barboursville, West Virginia
Huntington District
Underway

The Mud River Sewage Lagoon Section 14 Project was initiated in 1992, pursuant to the authority of Section 14 of the Flood Control Act of 1946.

The village of Barboursville West Virginia operates a wastewater sewage treatment lagoon along the Mud River providing service to approximately 1400 customers. Riverbank erosion and failures were displacing and endangering the sheetpile walls and levee which are an integral part of the lagoon. Additional failures in this area would have breached the lagoon causing untreated wastewater to flow into the Mud River.

Construction of the project included the removal of debris, the excavation of failed soil and the placement of free draining granular fill, geotextile filter, and a minimum of 27 inches of stone with a maximum top size of 18” were placed for a total bank length of approximately 860 feet. This stone slope protection was successful in preventing breaching of the Mud River Sewage Lagoon during following high water events.

Floodplain-Information Studies

The Huntington District has completed two floodplain-information studies on the Guyandotte River basin: Mud River at Milton (pop. 2,260), completed in 1968; and the Buffalo Creek (Logan County) special investigation, completed in 1972.

Twelvepole Creek Basin

Twelvepole Creek basin is located in southwestern West Virginia, in Cabell, Wayne, Lincoln, and Mingo counties. It has a drainage area of 441 square miles of hilly and mostly wooded terrain. The watershed is elongated and irregular in shape, and is about 46 miles long, with a maximum width of 12 miles. The major axis is oriented in a general north to south direction. Elevations in the basin range from 1650 feet near the headwaters to 515 feet near the mouth.

Twelvepole Creek is formed by the junction of East Fork and West Fork, almost a mile south of Wayne (pop. 1,128), the seat of Wayne County. The creek flows 32 miles northward to its confluence with the Ohio River between Ceredo (1,921) and Huntington (54,623), 313 miles below Pittsburgh.

Except for Huntington, Ceredo and Wayne are the only population centers of any size. Less than 10 percent of the basin's total population is located in urban areas. Agriculture and the production of oil and natural gas, coal mining, and light industry are the principal pursuits, with a large part of the working population commuting for employment outside the basin, especially to Huntington.

Two multipurpose lakes have been completed in Twelvepole Creek basin, which are East Lynn Lake and Beech Fork Lake.

East Lynn Lake
Huntington District

East Lynn Lake is on East Fork of Twelvepole Creek near East Lynn (pop. 250), in Wayne County. The dam controls the 133-square-mile drainage area. Construction of the project, built under authority of the Flood Control Act of 1938, was begun in 1965, and the project was placed in operation in 1972. The project was completed in 1980 at a cost of $37,026,000.

The project is operated for the reduction of flood damage along Twelvepole Creek and as a unit in the comprehensive plan for flood control in the valley of the Ohio River. It is estimated that since the project was placed in operation it has prevented some $63 million in flood damage through fiscal year 1997.

The dam is an earthfill structure 652 feet long, rising 113 feet above the streambed. The outlet works for normal flow is a tunnel controlled by sluice gates; high flows are accommodated by an uncontrolled saddle spillway with a crest length of 230 feet.

The minimum pool, at elevation 656 feet, with a surface area of 823 acres, is maintained during winter months. A seasonal (summer) pool at elevation 662, with a surface area of 1,005 acres, is maintained from May through September for recreation and fish and wildlife conservation. Flood-control storage capacity, at elevation 701, ranges from 65,300 acre-feet in summer to 70,800 acre-feet during the winter-spring flood season. The seasonal pool measures 12.7 miles along the main stream.

Since the pool was impounded, visitation has exceeded the capacity of the public-use facilities. In 1997, visitation was about 309,700. To alleviate the crowded conditions, parking facilities were enlarged in 1974, and construction for the expansion of facilities at the Overlook Point and the East Fork Camping Areas was undertaken. This work was completed in 1980. Existing development includes facilities for camping, picnicking, boating, fishing, and sight-seeing. A nature center has also been provided.

Beech Fork Lake
Huntington District

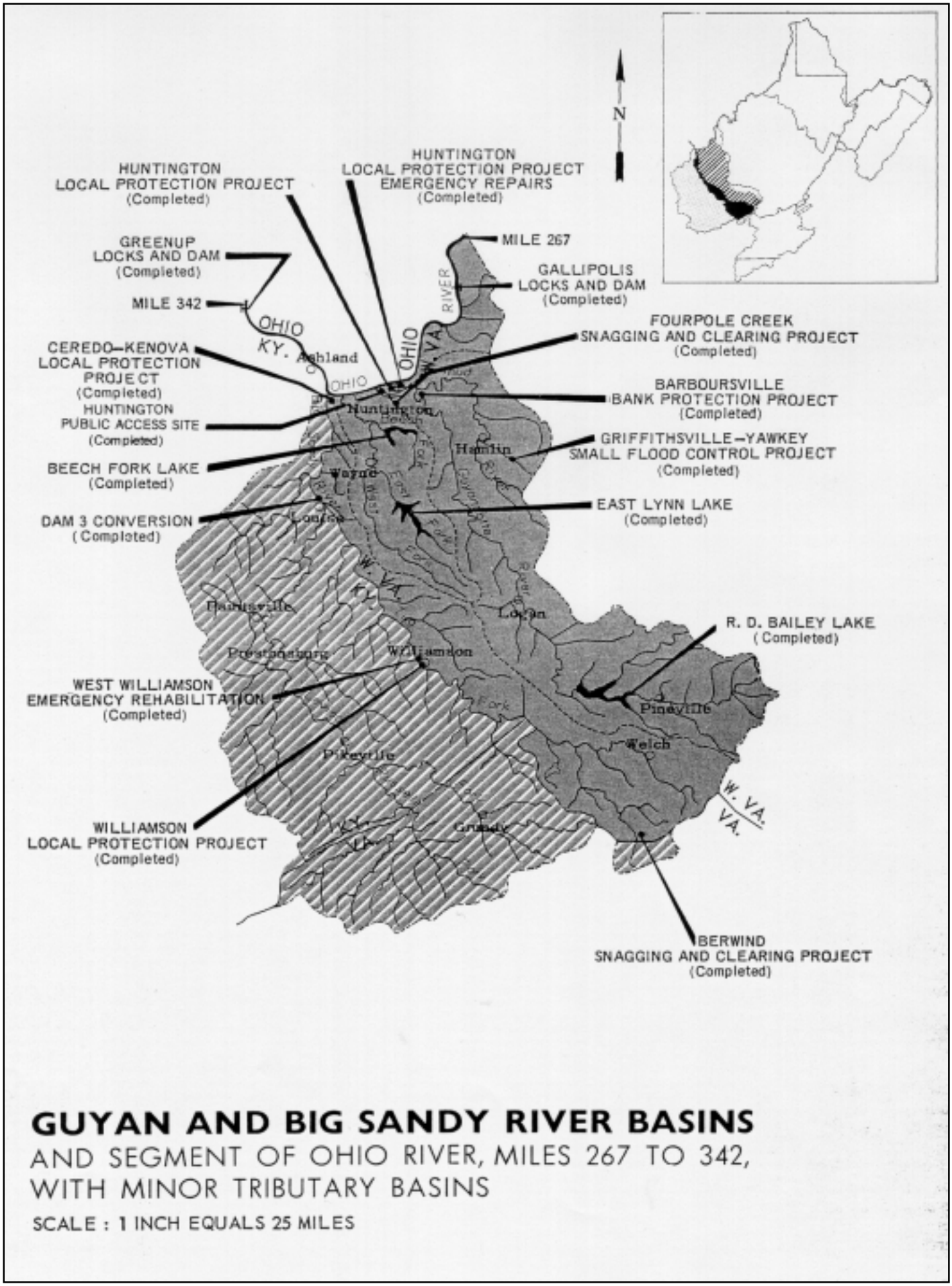
Beech Fork Lake is located on Beech Fork of Twelvepole Creek in Wayne and Cabell counties. The dam, 2 miles southeast of Lavalette (pop. 600), and 9 miles south of Huntington (54,844), controls the drainage of 78 square miles. Construction was authorized in the Flood Control Act of 1962. Building was begun in June 1970 and was opened for recreational activities in May 1978. The dam was completed, and impoundment was begun early in 1978. The cost of the project was $41,988,000, all Federal. Cost savings from flood damage prevention since the project was placed in operation are estimated at $17 million through the Spring of 1998.

The lake is operated as a unit in the comprehensive plan for flood control in the Ohio River valley. Project plans include the development of the lake's general and fish and wildlife recreational potential.

The dam is earthfill, 1,080 feet long, with a height of 86 feet above the streambed. The outlet works for normal discharge consist of an 8-foot 6-inch by 11-foot 3-inch split-circle conduit. An uncontrolled spillway with a crest length of 80 feet is located 500 feet from the left abutment.

The minimum pool, at elevation 583.5 feet, with a surface area of 450 acres, is maintained during the winter; a seasonal pool, at elevation 592 feet, having a surface area of 720 acres, is provided during the summer recreational season. Floodwater- control storage capacity, at elevation 614.5 feet, ranges from 28,360 acre-feet in summer to 33,340 acre-feet in winter. The winter storage capacity is the equivalent of 8 inches of runoff from the area drained.

Recreational development by the Corps at Beech Fork Lake includes facilities for picnicking, swimming, boating, fishing, hiking,, and sight-seeing. The State of West Virginia operates part of the project as a State Park with campground facilities and a wildlife management area. Visitation in 1997 was 720,883.



GUYAN AND BIG SANDY RIVER BASINS

AND SEGMENT OF OHIO RIVER, MILES 267 TO 342,
WITH MINOR TRIBUTARY BASINS

SCALE : 1 INCH EQUALS 25 MILES

Big Sandy River Basin in West Virginia

Description of Area

The Big Sandy River basin headwaters originate with Levisa Fork in western Virginia and eastern Kentucky and with Tug Fork in western Virginia and southern West Virginia. These two principal tributaries flow northward to their junction at Louisa (pop. 2,067), Kentucky, and Fort Gay (pop. 865), West Virginia, to form the Big Sandy River. The Big Sandy is the boundary between West Virginia and Kentucky and flows 27 miles northward to its confluence with the Ohio River at Kenova, West Virginia, and Catlettsburg, Kentucky, 317 miles down river from Pittsburgh.

The Big Sandy basin has an overall length of 105 miles, a maximum width of 91 miles, and a drainage area of 4,290 square miles. The only major tributary to the Big Sandy River other than the two forks is Blaine Creek in Kentucky, with a length of about 50 miles.

Levisa Fork has a length of about 164 miles—34 miles in Virginia, and 130 miles in Kentucky. The principal tributaries, in descending order, are Pound River, in Virginia; Russell Fork, in Virginia and Kentucky; and Beaver Creek, Johns Creek, and Paint Creek, in Kentucky.

Tug Fork is 154 miles long. The upper 55 miles lies within West Virginia, 5 miles forms part of the boundary between West Virginia and Virginia, and the remaining 94 miles forms the boundary between West Virginia and Kentucky. The principal tributary of Tug Fork is Dry Fork, a headwater stream in West Virginia with its upper reaches originating in Virginia.

Status of Corps Work

The Big Sandy River basin in West Virginia contains four completed Corps projects. These include a local flood-protection project at Williamson, an emergency rehabilitation project at West Williamson, a snagging and clearing project at Berwind, and a bank-protection project at the Kenova Water Facility at Neal.

Studies for a comprehensive program of flood-damage reduction for the Tug Fork valley in West Virginia, Kentucky, and Virginia were authorized by Congress in the Water Resources Development Act of 1974 and were completed in 1982.

The resulting Tug Fork Flood-Damage-Reduction Plan recommended six local flood-protection projects for construction in West Virginia. Nonstructural measures were recommended for those eligible structures outside the local flood-protection projects. So far, only the Williamson- and Matewan-area projects, consisting of three local flood-protection projects, have been approved for construction and nonstructural features. The West Williamson floodwall project was completed in 1989. The (replacement) Williamson Central Business District floodwall was completed in 1991. The Matewan fill/floodwall project is scheduled to begin construction in 1992.

A floodplain-information study for the Big Sandy River in Wayne County was issued in 1972.

Kenova Municipal Water Facility
Huntington District

Bank erosion along the Big Sandy River at Neal, in Wayne County, was endangering the Kenova Water Plant. The contract to protect 600 feet of a shoreline at the Kenova Water Works was completed in June 1991 at a construction cost of $387,000. The project was cost shared with the non-Federal sponsor, the City of Kenova, West Virginia.

Tug Fork Basin Projects

Berwind Snagging and Clearing Project
Huntington District

The Berwind project was authorized under authority of Section 3 of the River and Harbor Act of 1945 and Section 208 of the Flood Control Act of 1954. It's located on Dry Fork, a tributary of Tug Fork of Big Sandy River in McDowell County. The project consisted of snagging and clearing about 7,000 feet of stream channel to alleviate the flood problem at Berwind (pop. 700). The work was done in 1971 and 1972.

Matewan Local Flood-Protection Project
Huntington District

The Matewan Local Flood-Protection Project was authorized under Section 202 of the Energy and Water Development Act of 1981 (PL 96-367). The Matewan project consists of four separate work items: (1) construction of a floodwall on top of an engineered fill in the Matewan Central Business District to the elevation of the Standard Project Flood, plus freeboard; (2) construction of an engineered fill in the Mate Creek area to the elevation of the April 1977 flood, plus freeboard; (3) flood-proofing of eligible structures to elevations above the April 1977 flood; and (4) relocation and resettlement to flood-safe sites of those structures for which floodproofing is not practicable.

The fill material for the Matewan project will be placed in such a manner that interior drainage and bearing capacity will allow the construction of a floodwall and some combination

of commercial, institutional, and residential structures on the Mate Creek and Central Business District fills. About 435,000 cubic yards of fill material will be needed. Additional protection for the Matewan Central Business District will be provided by constructing a concrete inverted "T" cantilever wall with a flat base along the outer perimeter of the fill. The wall is designed to an elevation providing Standard Project Flood protection, plus freeboard. The design of the floodwall includes three railway and four roadway gated openings and three pedestrian openings. In order to accommodate construction of the two fills and the floodwall, both State Rt. 49 and State Rt. 9 will be relocated as part of the Matewan Local Protection Project. Construction was started in September 1992 and is scheduled for completion in late 1996.

In conjunction with the fill and floodwall construction, a new interior storm-drainage system will be installed to direct internal storm water to an 18,000 GPM pumping station located adjacent to Mate Creek. The total estimated cost of the Matewan structural fill/floodwall project is $51,700,000.

The Matewan Area Nonstructural program is nearing completion at this time. Currently, 29 structures have been successfully floodproofed by raising-in-place, and an additional 25 structures have been purchased under the voluntary floodplain evacuation program. The nonstructural program is expected to be completed in 1996 at a total estimated cost of $12.4 million.

Lower Mingo County, West Virginia, Nonstructural Project

Huntington District

In Progress

The Lower Mingo County, West Virginia, Nonstructural Project was authorized by Section 202 of the Energy and Water Development Act of 1981 (PL 96-367). The recommended nonstructural project consists of the lower part of Mingo County, West Virginia, including the Town of Kermit. The project area extends from the downstream city limit of Williamson, West Virginia, to the Mingo-Wayne County line. The project area includes approximately 829 residential and nonresidential structures.

The Mingo County Commission is serving as the non-Federal sponsor for the project. The Commission receives financial assistance from the West Virginia Housing Development Fund and a Community Improvement Assessment District formed under a new state law. The Project Cooperation Agreement was executed by the Mingo County Commission and the Huntington District in November 1992. A landowners meeting was held in January 1993 to announce the start of the nonstructural program.

The program has been divided into four phases for efficient implementation. The project is expected to be completed in 1999. The total estimated project cost is $82 million.

Williamson Nonstructural Project

Huntington District

The Williamson Area Nonstructural Project was authorized by Section 202 of the Energy and Water Development Act of 1981 (PL 96-367) and approved for implementation by the Assistant Secretary of the Army (Civil Works) in April 1985. The project consists of floodplain-evacuation and resettlement and floodproofing activities. The program is designed to compliment the Williamson Area structural projects by using nonstructural flood-damage-reduction measures for those structures not protected by the structural projects. The areas primarily targeted for nonstructural measures are the Fairview and East Williamson communities, both of which were devastated by the April 1977 flood of record.

The floodproofing program was applied to those structures affected by the April 1977 flood that (1) were located outside the established regulatory floodway; (2) were physically stable and could be raised safely; (3) could be raised to an elevation of 1 foot above the April 1977 flood level without placing the first habitable or sales floor more than 12 feet above ground level; and (4) were located in the floodplain where floodwater velocities would not exceed 8 feet per second during a recurrence of the April 1977 flood. Agreements executed between the Corps and structure owners specified the owners' operation and maintenance responsibilities for the raised structure and prohibited future habitation of the area below the raised first floor. Structures that did not meet these criteria were designated for the floodplain evacuation program (see program description above).

Ninety-seven structures in the project area were originally determined to be eligible for the floodproofing program. Program participation exceeded 90 percent of those determined eligible for floodproofing. The floodproofing part of the program was completed in January 1991, resulting in the raising of 54 structures and the conversion of 40 structures to the floodplain evacuation program. The local sponsor is responsible for enforcing the terms of the executed agreements and the provisions of the local floodplain-management ordinance as they apply to these raised structures.

The evacuation portion of the program consists of three primary elements: (1) voluntary acquisition and evacuation of floodplain structures that can't be floodproofed; (2) the construction of a flood-safe residential subdivision to accommodate floodplain evacuees; and (3) local sponsor operation and maintenance of evacuated floodplains for habitat replacement under the FEIS and redevelopment of evacuated floodplains under existing floodplain-management ordinances.

Approximately 126 structures in the project area were eligible to be permanently evacuated. Program participation is high-resulting in the acquisition of 124 structures to date.

All structures are being acquired using standard real-estate acquisition procedures with last-resort housing applied when necessary. Approximately 35 acres of evacuated floodplain land have been allocated for either replacement mitigation habitat or redevelopment under existing floodplain ordinances. Floodplain lands set aside for wildlife mitigation will be operated and maintained by the local sponsor; lands set aside for redevelopment will be declared excess to the project and disposed of through GSA procedures.

The Valley View housing and community development site is a residential subdivision for floodplain evacuees in the Williamson nonstructural project area. The site is located 2.3 miles from downtown Williamson on West Virginia 52/119. The site was developed to accommodate a total of 56 single-family housing units. Construction of the Valley View site was completed in 1989 at a total cost of $2.4 million. All 56 lots have now been taken by eligible homeowners and home construction is complete. The City of Williamson will assume operation and maintenance of the housing site.

Total estimated cost for the Williamson Nonstructural Project is $24.5 million.

Williamson Central Business District Flood-Protection Project
Huntington District

The Williamson Central Business District flood-protection project was authorized for construction by Section 202 of the Energy and Water Development Act of 1981 (PL 96-367). The project is located in the central business district of Williamson, West Virginia, between river miles 57.0 and 57.6 on the right descending bank of the Tug Fork. The project consisted of the construction of 2,900 linear feet (LF) of sheetpile-cell floodwall structure, 600 LF of concrete wall, the construction of two pumping stations (30,000 and 70,000 GPM), five gated openings for road and railway traffic, and an interior storm-drainage collection system. The construction contract was awarded for $42,000,000 in June 1988 and was completed in late 1991. Total project costs were $63.5 million. The local sponsor is responsible for operation and maintenance of the floodwall and appurtenances.

This project replaces an older flood-protection project constructed by the Corps of Engineers in the Williamson CBD in 1963 that was overtopped by the April 1977 flood with devastating results (see description above).

West Williamson Local Flood-Protection Project
Huntington District

The West Williamson local flood-protection project was authorized under Section 202 of the Energy and Water Development Act of 1981 (PL 96-367). The project purpose is flood protection for the West Williamson section of Williamson to the level of the Standard Project Flood. The floodwall extends from river mile 55.3 to mile 56.6 on the right descending bank of Tug Fork. A contract for construction of the required 6,000 feet of concrete floodwall was awarded in November 1986 for $24,900,000 and was completed in 1989. In addition to the floodwall, the construction included a 40,000 GPM pumping station, four gated openings for road and railroad traffic and two pedestrian openings. The total project cost was $42,100,000.

This floodwall project replaces an older existing flood-protection project in the West Williamson area consisting of a pump station and the embankment of the Norfolk and Southern Railway, which provided protection for a portion of the local community. The old pumping station was removed as part of the new floodwall construction.

Williamson Area Snagging and Clearing Project
Huntington District

To offset potential increases in Tug Fork flood heights due to construction of the Williamson and South Williamson (Kentucky) structural floodwall projects, snagging and clearing was accomplished along 3.4 miles of the Tug Fork in the Williamson project area. Project sponsors are responsible for maintenance of the snagging and clearing project. The project was completed in July 1988 at a total cost of $900,000.

Conversion of Big Sandy Dam 3 at Louisa-Fort Gay
Huntington District

Section 62 of the Water Resources Development Act of 1974 authorizes the Corps of Engineers to perform necessary work for reconstructing Dam 3 on the Big Sandy River at Louisa, Kentucky, and Fort Gay, West Virginia, as a fixed-type structure. The structure is used by the two communities for water-supply impoundment. Construction was completed in January 1980 at a cost of about $440,000.

Planning Studies

Tug Fork Valley Flood-Damage-Reduction Plan
West Virginia, Kentucky, and Virginia
Huntington District

The Tug Fork basin was devastated in April 1977 by the flood of record for the basin, causing an estimated $608 million (Oct 91 PL) in damage. As a direct result of the losses from this flood, the Energy and Water Development Appropriations Act of 1981 (PL 96-367) provided authorization for developing flood protection in the Tug Fork basin. Section 202 of that legislation directed the Secretary of the Army, acting through the Chief of Engineers, to design and implement, at full Federal expense, flood-damage-reduction measures in those areas affected by the flood.

Based on the Section 202 legislation, the Corps of Engineers submitted its proposed plans for flood-damage- reduction measures to the Assistant Secretary of the Army for Civil Works (ASA(CW)) in the "Section 202 General Plan for Implementation," (General Plan) dated 28 April 1982. The ASA(CW) approved the General Plan with immediate implementation of the Williamson, West Virginia, area structural components of the plan. However, the ASA(CW) reserved the approval for implementation of all remaining plan components pending submittal of future Specific Project Reports (SPRs) for each plan increment.

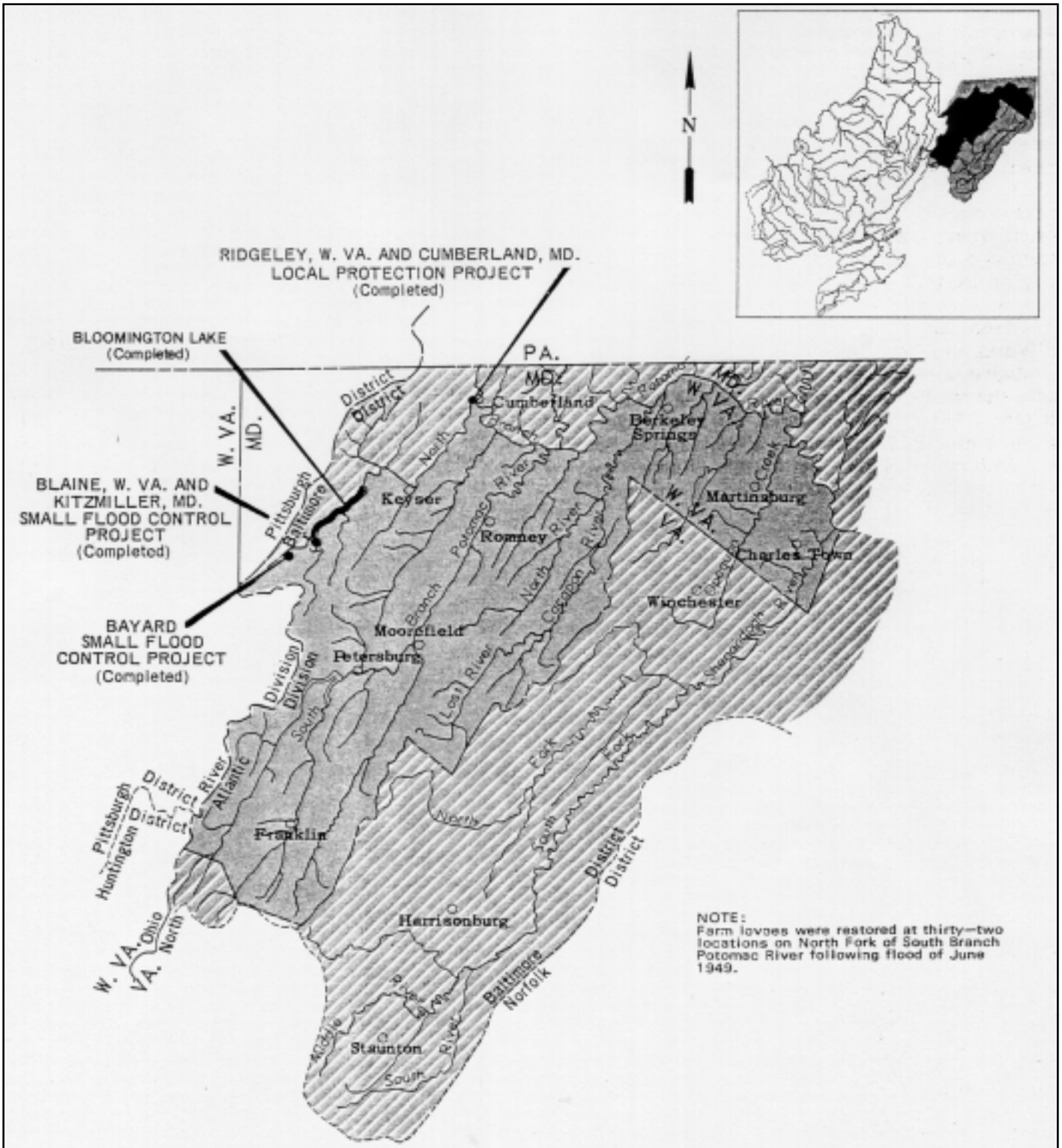
Subsequent SPRs have been approved for Matewan, West Virginia, initiating the implementation of structural and nonstructural measures in this area. SPRs recommending nonstructural solutions to the flooding problems for several project areas throughout the Tug Fork basin are currently ongoing. These project areas include the Hatfield Bottom Project Area, located within the corporate limits of Matewan, West Virginia, and the Upper Mingo County project area extending from the upstream limit of the Williamson Nonstructural Project area to the Mingo-McDowell County line exclusive of the Hatfield Bottom and Matewan Structural and Nonstructural) project areas.

Navigation Study
Big Sandy River
Huntington District

Feasibility studies of navigation improvements on the Big Sandy River were conducted under the authority of a resolution of the House Committee on Public Works and Transportation adopted 25 April 1978. No improvements were recommended as a result of the study, which was completed in 1986.

Floodplain-Information Studies

A floodplain-information report for the Big Sandy River in Wayne County, West Virginia, was issued in 1972, and a special flood-hazard-information report for Tug Fork was completed in 1978.



UPPER POTOMAC RIVER BASIN

SCALE : 1 INCH EQUALS 25 MILES

Potomac River Basin in West Virginia*

Description of Area

The Potomac River drains 14,670 square miles of the mid-Atlantic region of the United States. All of the District of Columbia, about 36 percent of Maryland, 15 percent of West Virginia, 14 percent of Virginia, and 4 percent of Pennsylvania lie within its drainage basin. The water resources of the Potomac River system serve an area somewhat greater than that contained in the drainage-area boundaries. Nine-tenths of the service area's population of around three and a quarter million is concentrated in the Washington metropolitan area.

The Potomac originates in the rugged Allegheny Mountains. From there the stream breaks eastward through a series of mountain barriers, collecting the flow of tributaries from the narrow valleys of its western watershed, from the Shenandoah Valley west of the Blue Ridge, from the rolling hills of the Piedmont, and from the coastal plain east of Washington, in its path to Chesapeake Bay. The Potomac leaves West Virginia at Harpers Ferry (pop. 340).

In contrast with the Washington area, the West Virginia portion of the Potomac basin is sparsely populated, accounting for only some 3 percent of the basin's total inhabitants. The basin's economy in West Virginia is diversified, with all sectors playing important roles. West Virginia ranks seventh in the nation in apple production. Recent gains in manufacturing and wholesaling employment have given the region a great deal of stability. The proximity to Washington (pop. 543,213), just under 100 miles southeast of West Virginia's panhandle, also exerts an influence on the area's economy. Martinsburg (14,712) is the dominant West Virginia municipality in the Potomac basin.

Status of Corps Work

Four completed water-resource projects are located on North Branch Potomac River. One of these is a multipurpose reservoir project, two are small flood-control projects completed under special continuing authority, and the fourth is a local flood-protection project. The reservoir project, the local flood-protection project, and one of the small flood-control projects are partly in West Virginia and partly in Maryland. An emergency-repair operation, involving South Branch Potomac River and its tributaries in West Virginia, has also been completed.

A Potomac River basin plan is in effect to guide water-resource development.

North Branch Potomac River Basin Projects

Bayard Small Flood-Control Project
Baltimore District

A small flood-control project at Bayard (pop. 425), in Grant County, was completed under authority of Section 205 of the Flood Control Act of 1948. The town is located on the right bank of North Branch Potomac River at the confluence of Buffalo Creek. The protective works consist of about 2,000 feet of channel improvement, 1200 feet of levees, 265 feet of reinforced concrete retaining walls, drainage structures, and the reconstruction of a highway bridge carrying West Virginia 90 over Buffalo Creek.

The works are designed to provide protection against a maximum flood of 5200 cubic feet per second. Flooding was caused primarily by the overflow of the badly obstructed and inadequately maintained channel of Buffalo Creek. The Federal cost of the project was $238,000, and local costs are estimated at $109,000—for a total project cost of $347,000. The completed project was transferred to local interests for operation and maintenance in 1964.

Blaine, West Virginia, and Kitzmiller, Maryland Small Flood-Control Project
Baltimore District

A small flood-control project was completed under authority of Section 205 of the Flood Control Act of 1948 on North Branch Potomac River at Blaine, West Virginia, and Kitzmiller (pop. 275), Maryland. The protection facilities consist of 4,700 feet of channel improvement, 5,800 feet of levees, and drainage structures. The project provides protection for the two communities against a maximum flood of 52,000 cubic feet per second, which is 55 percent greater than the largest flood of record. About $867,000 in damage would be prevented in the event of a recurrence of the 1924 flood.

The Federal cost of the project was $502,000, and the local costs were about $92,000. The completed project was transferred to local interests for operation and maintenance in 1964.

Jennings Randolph Lake
West Virginia and Maryland
Baltimore District

The Bloomington Lake project was authorized by Congress in 1962 as a unit of the comprehensive water-development plan for the Potomac River basin. Construction was begun in

**Information based on 1994 data.*

1971 and completed in 1981. The name was changed to Jennings Randolph Lake in the Water Resources Development Act of 1986.

The dam is located in Mineral County, West Virginia, and Garrett County, Maryland, on North Branch Potomac River about 8 miles upstream from the mouth of Savage River and the community of Bloomington (400), Maryland. The project provides water supply, water-quality control, flood control, and recreation.

The project required the relocation of about 11 miles of the Western Maryland Railway Line.

The dam is a rolled earth and rockfill structure, rising 296 feet above the streambed and extending 2,130 feet across the valley. A spillway with five tainter gates, each 32 feet high and 42 feet wide, has been built at the left abutment of the dam to regulate floodflows. A dike 900 feet long to the left of the spillway closes off a low area. Outlet works in the right abutment, including a 330-foot-high intake control tower with hydraulic slide gates, provide downstream water-quality regulation.

With a full conservation pool, the lake is about 6.6 miles long and has a surface area of 952 acres. Of the 130,900 acre-feet of storage available, 36,200 acre-feet is for flood control, 92,000 acre-feet for water supply and water quality, and 309 acre-feet for dead storage. The storage for low-flow releases has increased the dependable flow of the river at Luke, Maryland, from 93 cubic feet per second to 120 cubic feet per second. The project, controlling drainage from 263 square miles, will prevent about 42 percent of the average annual flood damage along North Branch Potomac River. Substantial benefits will also result from water-quality improvements and from recreational use. The Federal cost for the project is $174,480,000. Cost sharing for water supply, estimated at 33.2 percent of the total cost, is required under the terms of the authorizing documents.

Recreational development includes a boat-launching ramp and picnic area and campground on the West Virginia side of the lake. The State of Maryland is constructing a boat-launch facility, which is expected to be completed in 1996. Mineral County, West Virginia, operates a whitewater access facility in Barnum, West Virginia, about one mile below the dam. Access roads and parking areas are provided for the recreation areas. Visitation in 1994 accounted for 174,400 visitor hours. Cost savings associated with flood damage prevented by the Jennings Randolph Lake project through 1994 are estimated at $116,839,000.

Ridgeley, West Virginia, and Cumberland, Maryland Local Flood-Protection Project
Baltimore District

Ridgeley (pop. 749) is in Mineral County on the south bank of North Branch Potomac River, opposite Cumberland (22,341), Maryland. Protective works for these communities include about 3.3 miles of channel improvements on the North Branch and its tributary, Wills Creek, supplemented by a system of earth levees and concrete floodwalls. Other project features include three pumping stations with related interior drainage facilities and eight pressure conduits whose lengths total 11,800 feet. An industrial water-supply dam, three highway bridges, and a railroad bridge were reconstructed.

The project provides protection for Ridgeley and Cumberland against a flood 28 percent greater than the record high water of 1936. For the two communities, a total of $23,562,000 in flood damage has been prevented through 1994. Of this total $23,000,000 was realized during the November 1985 flood. No significant flooding has occurred since.

The original project was completed and transferred to local authorities for operation and maintenance in 1959. Channel improvement through the Smith's Island portion of the project was carried out during 1963 and 1964 at a cost of $217,000, of which $198,000 was provided under the Public Works Acceleration Act. The total cost of the project was $18,731,000, of which $15,831,000 was borne by the Federal Government. The United States will maintain the improved channels. Operation and maintenance of the balance of the project is the responsibility of Cumberland and Ridgeley.

South Branch Potomac River and Tributaries

Farm Levees, Other Flood-Control Works, and Emergency Repairs
Baltimore District

During the destructive flood of June 1949, the entire South Branch area suffered damage costing an estimated $6 million. The North Fork of South Branch Potomac River was completely clogged by a mountain slide. This blockage was cleared and about 5 miles of farm levees was restored at 32 locations in Hardy, Hampshire, Grant, and Pendleton counties. Federal costs for the work were $69,100. The work was performed under authority of Public Law 99, 84th Congress.

Petersburg Local Flood-Protection Project
Baltimore District
Authorized, Not Started

The City of Petersburg, in Grant County, West Virginia, is subject to flooding from the South Branch Potomac River. Serious floods have occurred in March 1936, June 1949, and November 1985. The most recent flood, an approximate once-in-400-years event, was more than twice the flow of any previously recorded flood and caused a total of about $33 million (October 1989 price levels) in damage in Petersburg.

In response to the flooding problem, the Corps of Engineers and the Interstate Commission on the Potomac River basin completed a cost-shared feasibility study in January 1990 to identify and evaluate possible solutions. A range of possible measures to solve the Petersburg flooding problem was examined. These measures included levees, floodwalls, channel improvements, bridge modifications, and nonstructural alternatives.

Based on this analysis, the District Engineer recommended the plan that would provide 100-year flood protection for North Petersburg, South Petersburg, and the Grant County Airport Industrial Park. The recommended plan would prevent about 90 percent of the potential average annual flood damage in Petersburg. Local interests support the recommended plan. Grant County has stated its intent to be the local sponsor for the project.

The recommended plan includes 19,370 feet of earth levee, 920 linear feet of floodwall, 35,430 cubic yards of channel excavation near the Main Street bridge, bridge replacement/modification, environmental mitigation, and appurtenant project features such as ramps, closures, riprap, relocations, and ponding areas for local drainage. The total first cost is estimated at $23,900,000, including future price escalation through project completion. Average annual benefits are estimated at $2,909,000, and average annual costs are estimated at $2,287,000. The benefit-to-cost ratio is 1.30, and net benefit-to-cost ratio are estimated at $729,000. Environmental mitigation will ensure that there will be no significant adverse environmental impacts.

The project was authorized for construction by the Water Resources Development Act of 1990, and preconstruction engineering and design for the project has been completed.

Moorefield Local Flood-Protection Project

Baltimore District

Authorized, Not Started

The Town of Moorefield in Hardy County, West Virginia, is subject to flooding from the South Fork and the South Branch Potomac River. Serious floods have occurred in March 1936, June 1949, and November 1985. The most recent flood, approximately once-in-500-years event on the South Fork, produced flow almost three times as much as any previously recorded and caused some $32.7 million (October 1989 price levels) in damage in Moorefield.

In response to the flooding problem, the Corps of Engineers and the Interstate Commission on the Potomac River basin completed a cost-shared feasibility study in March 1990 to identify and evaluate possible solutions. A range of possible structural and nonstructural measures to solve the Moorefield flooding problem was examined, including levees, floodwalls, channel improvements, bridge modifications, and nonstructural alternatives.

On the basis of the evaluation, the District Engineer recommended a levee plan with associated appurtenances that would provide 100-year flood protection for both North and South Moorefield. The recommended plan would prevent about 85 percent of the average annual damage in Moorefield. Local interests support the recommended plan and view it as a cornerstone in the economic redevelopment of the Moorefield area following the November 1985 flood. The Town of Moorefield has stated its intent to be the non-Federal sponsor for the project.

The recommended plan includes 21,735 feet of earth levee, 1,290 feet of floodwall, replacement of the South Branch Valley Railroad bridge at a higher elevation just upstream from the existing structure, environmental and cultural mitigation, and appurtenant project features such as ramps, closures, riprap, and relocations. The State of West Virginia has indicated its desire to design and construct the railroad bridge as part of the non-Federal share of the project cost. A cost-sharing credit will be applied toward the non-Federal share for this work, generally in accordance with Section 104 of the Water Resources Development Act of 1986.

The total first cost of the project is $21,700,000, including future price escalation through project completion. Average annual benefits are estimated at $2,016,000, and average annual costs are estimated at $1,817,000. The benefit-to-cost ratio is 1.10, and net benefits are estimated at $199,000. Environmental mitigation will ensure that there will be no significant adverse environmental impacts.

The project was authorized for construction by the Water Resources Development Act of 1990, and preconstruction engineering and design has been completed.

Jennings Randolph Lake Reallocation Study

Baltimore District

Increasingly, population, industrial development, and economic growth in the Potomac River basin are resulting in increased demands on the basin's water resources. The State of Maryland recently enacted consumptive-use legislation mandating that consumptive users replace their losses during extreme droughts or shut down their operations. This regulation was intended to mitigate the negative environmental impacts of consumptive uses during periods of extreme low-flow.

To comply with this law, the region's consumptive users are turning to the basin's existing reservoirs. One reservoir currently being investigated for this use is the Corps' Jennings Randolph Lake, on the North Branch Potomac River. A study to determine the feasibility of reallocating storage at Jennings Randolph was begun in August 1988.

The first phase of the study, the reconnaissance phase, was completed in June 1989, with the recommendation to continue with the detailed, feasibility study. The feasibility

phase was initiated in December 1990, with the State of Maryland acting as the non-Federal sponsor. In the spring of 1992, study activities were suspended due to concerns regarding technical issues. A detailed investigation of the issues and a reassessment of the remaining study tasks resolved the concerns, and study activities were resumed in February 1995.

Previous formulation efforts have identified three reallocation alternatives consisting of lake level rises of 6, 9, and 12 feet above the current permanent pool; in addition, seasonal pool operations will also be investigated. Key issues that will be addressed during the feasibility study include downstream water-quality impacts, the potential for more frequent use of the spillway and the potential erosion associated with its use, potential decrease in flood-damage reduction, and water supply. The remainder of the study is focusing on evaluating the trade-offs of the different levels of reallocation. The draft feasibility report is scheduled for public review in December 1996, with a final report scheduled for completion in March 1997. The feasibility study cost of $1,424,000 is being cost-shared 50-50 with the Maryland Department of Natural Resources.

North Branch Potomac River Environmental Restoration Study
Baltimore District

The North Branch Potomac River extends 97 miles and drains 1,328 miles of West Virginia, Maryland, and Pennsylvania. The watershed features include the Corps of Engineers' multipurpose Jennings Randolph Lake project and the Savage River Reservoir project, which was partially constructed by the Corps of Engineers. In addition, three Federal local flood protection projects are directly located on the North Branch. Despite their positive benefits, the construction of these projects has contributed to the degradation and loss of the region's fish and wildlife habitats. An estimated 2,000 acres and 20 miles of river reach have been impacted by the existing Federal projects. Of particular concern are the degraded reaches in the Savage and North Branch Potomac rivers adjacent to a regionally recognized trophy trout stream.

In April 1994, the Corps of Engineers initiated a reconnaissance study of the basin to investigate fish and wildlife habitat, water quality, recreation, flood-damage reduction, and related opportunities in the basin. A particular focus of the study has been Jennings Randolph Lake, the portion of the watershed draining into the lake, and the 8-mile river corridor between the lake and the confluence with the Savage River. The purpose of the reconnaissance study is to develop a water-resource plan for the North Branch Potomac River basin that identifies projects implementable by the Corps of Engineers as well as other Federal, State, and local agencies. The study will determine the economic, engineering, and environmental feasibility of potential measures to address problems in the basin, including recreation, water quality, environmental restoration, and flood-damage-reduction projects. Continued studies by the Corps of Engineers will be recommended for those projects that appear feasible and are in the Federal interest. The study, which is 100-percent Federally funded, is scheduled for completion in July 1995. A follow-on cost-shared feasibility study is scheduled to be initiated in the spring of 1996.

Jennings Randolph Lake Section 1135(b) Study
Baltimore District

In 1994, the State of Maryland asked the Corps to review project operations and facilities at Jennings Randolph Lake, with a view toward restoring fish and wildlife habitat. Of particular concern is the occurrence of gas supersaturation below the lake during high-water releases from the reservoir. There is evidence that gas supersaturation in the tailwater and downstream locations exceeds recommended levels for populations of finfish and invertebrates.

The study of the gas supersaturation problem will be conducted under the authority of Section 1135(b) of the Water Resources Development Act of 1986, as amended. The purpose of the study will be to identify potential operational and structural modifications to reduce or eliminate the negative impact of gas supersaturation on the aquatic resources of the North Branch Potomac River. The feasibility phase of this study is scheduled to be initiated in the summer of 1995 and require 12 months for study analyses.

Other Corps Activities in West Virginia

In addition to carrying out planning and floodplain-information studies, designing and building projects, and performing routine operation and maintenance, the Corps of Engineers is responsible for a variety of other activities. These include flood fighting, repair and emergency work, disaster assistance, the administration of a permit program for the protection of navigable waters, open-channel and dredging operations, the removal of obstructions to navigation, and the provision of information, technical assistance, and advice to congress, non-Federal governments, and the public. It's impractical to cite all the many instances of such activities, but the following are examples.

Disaster Recovery Assistance
Huntington District

The Disaster Relief Act of 1974, Public Law 93-288, provides for Federal assistance to individuals, State and local governments, and designated private nonprofit medical-care facilities upon the declaration of a disaster by the President. The director of the Federal Emergency Management Agency (FEMA) is charged with the task of coordinating Federal disaster-relief efforts.

Under this program, the Corps of Engineers' Huntington District responded to the destructive April 1977 flooding along Tug Fork of Big Sandy River and in drainage areas eastward. Eleven West Virginia counties were declared major disaster areas. Recovery assistance was provided in Mingo, McDowell, Logan, Wyoming, Mercer, Raleigh, Summers, Greenbrier, Wayne, Lincoln, and Cabell counties.

The Corps of Engineers' mission at the outset was to consider the needs of the flood victims and to aid them in putting their communities back in operation. The next priorities were the reestablishment of utilities and other essentials for health and safety, and then the cleanup activities. During the entire recovery period, the Huntington District was available to provide technical advice and engineering services.

Early on, the Federal Disaster Assistance Administration (now FEMA) asked the Huntington District to perform damage surveys relative to several categories of eligible work under Public Law 93-288—debris removal, emergency protective measures, damage to public buildings and equipment, and damage to public utilities. FDAA also requested the Huntington District to engage contractors to remove floatable debris and other debris that had the potential of creating a damming effect along a 70-mile reach of Tug Fork.

Another assignment concerned the provision of emergency housing. At the request of the Department of Housing and Urban Development, the Huntington District designed and developed twelve mobile-home sites and five travel-trailer sites, where about a thousand victims of the flood were accommodated.

From 4 November through 7 November 1985, record floods occurred in central and eastern West Virginia, especially in the headstream areas of the Greenbrier, Potomac, Monongahela, and Little Kanawha rivers. A Presidential disaster declaration was signed on 7 November covering 29 counties: Barbour, Berkeley, Braxton, Calhoun, Doddridge, Gilmer, Grant, Greenbrier, Hampshire, Hardy, Harrison, Jefferson, Lewis, Marion, Mineral, Monongalia, Monroe, Morgan, Nicholas, Pendleton, Pocahontas, Preston, Randolph, Summers, Taylor, Tucker, Tyler, Upshur, and Webster.

Like West Virginia generally, the terrain of the disaster area is extremely rugged, and the region's heavily forested ridges, shallow soils, and steep slopes constitute a topography conducive to rapid runoff.

Aside from forestry, mining, and a scanty upland agriculture, development is concentrated along the bottomlands of the streams, and is subject to a strong storm- and flood-damage potential.

The flooding of November 1985 resulted in 42 people known dead, another five missing, and property damage in excess of $500 million.

The Corps of Engineers' mission initially was to aid the flood victims in putting their communities back into operation. Corps technical and engineering services were available during the entire recovery period.

The Federal Emergency Management Agency at the beginning gave the Corps of Engineers the responsibility of preparing Preliminary Damage Assessments (PDSs), and later Damage Survey Reports (DSRs), relative to all categories of work under the Disaster Relief Act. Then, on 21 November, the Corps was given the mission of removing debris from public and private property in cases where a health and safety hazard was involved.

The disaster area included parts of two Corps Divisions, Ohio River and North Atlantic, and three Corps Districts, Baltimore, Huntington, and Pittsburgh. The Huntington District was designated “Lead District” and supervised all disaster-recovery operations. Corps operations were concluded on 28 February 1986.

Disaster-Recovery Assistance
Pittsburgh District

Record-breaking cold temperatures during January and February 1977 and January and February 1978 resulted in

several ice buildups on all major rivers and tributaries. In both years, a severe major flood threat remained until mid-March, when disaster was averted by gradual warming and little precipitation. Several flash floods were also reported. Funds under Public Law 84-99 were employed for investigation, technical assistance, and Emergency Operations Center (EOC) operations.

At the request of the Federal Emergency Management Agency, Pittsburgh District conducted a detailed engineering study of a major landslide in McMechen, West Virginia. The study, which was completed in 1976, provided information on the size of the problem, cost estimates, emergency remedial measures, and methods of coping with the problem on a long-term basis. This report was provided to the State of West Virginia, which undertook the construction called for by the remedial measures.

Winter Navigation Problems on the Ohio River

During January and February 1977 and January and February 1978, ice conditions on the Ohio River seriously impeded or completely disrupted navigation for periods of more than 2 weeks. Of particular note was an ice jam that formed at Carrsville, Kentucky, on 17 January 1977, totally stopping navigation in that reach of the river until 1 February. That blockage, together with the slowdown of traffic due to massive amounts of ice throughout the river, resulted in traffic being reduced in late January and early February to about 15 percent of normal levels.

On 25 January 1978, rising flows due to rainfall forced already jammed ice upstream of Markland Dam into a gorge. When this jammed ice subsequently broke up, the ice mass moved down against the dam, taking with it numerous barges trapped in the ice. The pileup of barges and ice at Markland brought traffic to a complete stop.

Prompted by the episodes in those 2 years, the Ohio River Division Engineer appointed an ad hoc committee composed of Corps personnel to consider measures for coping more effectively with such problems.

The committee gathered information and views from varied interests, and on 14 June 1978, in Cincinnati, held a symposium on winter navigation at which reports of findings were presented. It was found that problems differed widely among the various locks and open-channel reaches, and that measures proposed were themselves generally subject to practical difficulties in their application. Experience on the upper Mississippi indicated that navigation problems resulting from ice conditions are primarily industry problems and can be dealt with effectively mainly through industry collaboration and industry initiative.

A Corps operational procedure perceived to have prospectively useful effects on navigation conditions during periods of ice formation was the “bouncing” (varying the levels) of the navigation pools as a means of breaking up ice on the river and keeping it moving downstream.

As recommended by the committee, a reporting system has been organized to deal with ice conditions on the Ohio and to keep operators informed concerning those conditions.

A statistical summary of ice conditions on the Ohio River at Cincinnati for the 90-year period from 1894 through 1964, prepared by the National Weather Service, showed that ice appeared on the river during 62 of the winters. The river was frozen over in 13 of the 90 years.

Heavy running ice was experienced about every other year on the average, but the river froze over (at Cincinnati) on an average of 1 year out of every 7. In some years, the duration of either condition was so short that the overall impact on navigation was minimal.

History of Corps Activities
Huntington, Pittsburgh, and Baltimore Districts

A program for the preparation and issuance of histories of Corps of Engineers field-operating agencies was begun by the Chief of Engineers in 1966. The first major history was that of the New Orleans District, published in 1971. Some 45 histories have so far been published, and the work on the other agency histories is in various stages of preparation, completion, or printing.

Regarding West Virginia, Corps histories have been published for the Huntington, Pittsburgh, and Baltimore districts. The history of the Huntington District, entitled *Men, Mountains, and Rivers*, was released in 1977. The history of the Pittsburgh District, titled *The Headwaters District*, was published in 1978. Both of these were prepared by Leland R. Johnson, Ph.D., a consulting historian from Hermitage, Tennessee. In 1989, Dr. Johnson and Jacque S. Minnotte, chief of Pittsburgh District's Engineering Division and the last Chief Engineering Advisor in the Corps when he retired in 1983, wrote *The Headwaters District Roundtables*, an eyewitness account of the District from 1936 to 1988. Dr. Johnson has also written histories of the Louisville District, Nashville District, and the Ohio River Division.

The Baltimore District history, *Mid-Atlantic Engineers*, an illustrated volume of about 200 pages, was published in October 1978. The author is Harold K. Kanarek, Ph.D., now in the District's Public Affairs Office. The book is available from the Government Printing Office (Washington, D.C. 20402) in hardback at $8.25.

Permit Program for Protection of Water Resources
Huntington and Pittsburgh Districts

Construction activities in, on, or over navigable waters of the United States are regulated by means of the Department of

the Army's Permit Program. The Huntington and Pittsburgh districts receive and process applications for such work in the navigable waters of West Virginia. Work requiring a permit includes but is not limited to, docks, submarine crossings, aerial cable crossings, bank revetments, dredging, and the deposition of dredged or fill material. The placement of fill or dredged material in any water of the state requires a permit.

Applications are evaluated in a public-interest balancing process—that is, anticipated benefits are balanced against the reasonably foreseeable detrimental impacts. In some cases the availability of practicable alternatives and the beneficial effects of proposed mitigation measures are considered in this process. Corps permits are issued only when the work involved is found, on balance, to be consistent with the public interest. Other provisions of law may be involved in certain special circumstances, such as those relating to historical resources, wild and scenic rivers, and endangered species. Moreover, when fill is involved, the work must also comply with the Section 404(b)(1) guidelines of the Clean Water Act, which specifically address adverse impacts on the aquatic environment.

Explanatory Notes

The following notes clarify some of the features of language or specific word usage employed in this booklet.

Acre-Foot. The capacity of a lake or reservoir is measured in acre-feet. An acre-foot is the equivalent of an acre of area filled to a depth of 1 foot. It contains 325,851 gallons.

Basin Maps. For convenience of comparison, the four maps directly concerned with the basin descriptions have been drawn on a uniform scale (1 inch to 25 miles). Each of the three Ohio River tributary basin maps covers more than a single stream basin, taking in not only one or more major stream basins but, as well, a related segment of the Ohio River and the basins of the minor direct tributaries to that segment. By combining the basin coverages in this way, a smaller number of maps is needed and place relationships are more readily grasped.

The Upper Potomac River basin map covers the portion of West Virginia draining to the Potomac, showing its relation to adjoining areas.

Bottomland. The flood plain of a stream, together with *relict* floodplain levels (terraces and terrace remnants) no longer subject to flood.

Design Flood. The selected flood against which a flood protective works is designed to provide protection.

Divide. The boundary separating drainage basins.

Dry Dam. A flood-control dam that impounds water only during floods, the stored water to be released after the potential for downstream flooding has been reduced. Normal streamflow is unimpeded.

Flash Flood. A flood caused by rainfall of high intensity with rapid runoff. The storm usually occurs over a small area.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain. Low land along a stream or other water body that may sometimes be flooded.

Gravity Dam. A dam, usually of reinforced concrete, so proportioned that, by its weight, it will resist overturning and sliding forces.

Historical Flood. Any known flood for which there is no gage record or other systematic or usable technical record.

Multipurpose Reservoirs. Most of the lakes built by the Corps of Engineers are designed to serve a variety of purposes, control of flood waters usually being a major project purpose. Another common project purpose is the augmentation of the low-flow of streams, most often for improving water quality, often for improving downstream fisheries, and sometimes for water supply or for navigation. Water supply can be taken directly from a lake or can be released for downstream withdrawal. An associated purpose of most reservoirs is the development of the lake area and contiguous project land areas for recreational activities and the management of fish and wildlife resources. Reservoirs may also be used to supply water for the generation of hydroelectric power.

The enumerated purposes are in a measure conflicting. Augmenting the low- flow of a stream, for example, requires the impoundment of water behind the dam, to be released when needed, while the flood-control objective requires that storage space be kept available for the retention of storm runoff to prevent downstream flooding. Hydropower generation entails varying the release rate to meet power needs, with accompanying variations in the lake level and in downstream flows. Management for downstream fisheries requires that optimal downstream flows be maintained for that purpose. For the recreational use of the lake, maintenance of a stable pool is a primary concern.

The design of a multipurpose dam calls for a balancing of project purposes so that all may be accomplished as fully and effectively as possible, taking account of legislative stipulations, public need and acceptability, and the programs of other governmental agencies, with due consideration also of costs.

Lake levels in a multipurpose reservoir are subject to wide variations through the year, often with a stable level maintained only during the summer recreational season. The variations as to level, surface area, and volume of storage are indicated in the lake descriptions in this booklet. In these descriptions an effort has been made to simplify and standardize pool nomenclature in the interest of ready understanding by the nontechnical reader.

The pool levels are expressed in feet above sea level. The lowest pool level for which the dam is operated is termed the minimum level. Other levels represent added blocks or increments of water storage for the purposes indicated in the project descriptions. The highest or maximum level refers to full pool elevation. The levels generally fall in three categories, representing year-round storage, seasonal (summer) storage, and space above the year-round and seasonal storage levels that is available for flood-control storage.

Where "maximum" is used in this booklet in relation to lake levels, the reference is to the full pool elevation. Full pool elevation will seldom be attained during the life of a lake designed for flood-control storage. Additional storage is nevertheless available above full pool elevation; that storage, measured in feet of depth, is referred to as "surcharge." A "freeboard" is provided from the surcharge elevation of the top of the dam as a safeguard against overtopping of the dam by waves or by wind action.

Outlet works are provided to allow the controlled release of water not in excess of full pool capacity. A spillway is provided to permit the passage of accumulated floodwaters in excess of full pool (surcharge storage), without overtopping the dam. A spillway is commonly installed with its crest at full pool elevation; such spillways are uncontrolled or ungated structures. Other spillways have their crests below full pool elevation and are equipped with gates that can be used to control the surface elevation of the impoundment.

The Corps of Engineers reservoirs in the Ohio River basin are operated as an integrated system for the impoundment of floodwaters, to accomplish a maximum reduction in downstream flood damage. Rapid basin-wide reporting of rainfall is required for accurate and timely prediction of flooding, so as to achieve optimum reservoir control. Constant analysis of stream conditions must be carried out while floods are developing and continuing, as a basis for release of stored water as soon as possible without worsening or prolonging the flooding, and thus enabling the reservoirs to regain their floodwater storage capability to meet possible subsequent needs. The key to flood-control capability is the availability of storage space to hold accumulating floodwaters. The Reservoir Control Center, in the Ohio River Division office in Cincinnati, synchronizes reservoir operations to provide for the best use of flood storage capacity and to avoid premature releases.

Navigation Dams and Locks. Most rivers used for navigation require the use of dams to maintain adequate water depths and reasonably stable water conditions the year around. Dams built to serve navigation needs change the natural gradient of the stream into a series of levels of pools, each providing adequate navigational depth.

Locks are used at the dams to raise or lower boats and barges from one pool level to another. The locks are gated chambers that are filled and emptied by gravity, using a system of conduits and valves designed to allow the movement of water into or out of the lock quickly but with a minimum of turbulence. The locks are operated to permit vessels to enter from either end at the elevation of the adjacent pool and to exit from the opposite end after the chamber is filled or emptied to reach the other level.

Ohio River Basin in West Virginia. The "in West Virginia" portion of this designation is meant to indicate that the treatment in the section so titled relates only to the portion of the basin within West Virginia. A similar "in West Virginia" designation is used for the treatments of the Monongahela River, Kanawha River, Big Sandy River, and Potomac River basins, each of which is contained only in part in West Virginia.

Populations of Communities. Throughout the booklet, numbers in parentheses are given after the names of communities to indicate the 1980 populations. Examples: Parkersburg (39,967); Ridgeley (994).

Recurrence Interval. The average interval of time, based on analysis of past records, that can be expected to elapse between floods of a given magnitude.

Right or Left Bank. The bank designation of a stream as one faces downstream.

River Mile. The distance designation of points along a stream, usually measured from the mouth, but on the Ohio River from the head of the stream, at Pittsburgh.

Tainter Gate. A radial gate (named for Jeremiah B. Tainter) used for regulating the flow of water over a spillway or dam. The upstream face of the gate is in the form of an arc centered on the gate hinge.